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(431)

Proceedings

THE

MISCELLANEOUS DOCUMENTS

OF THE

HOUSE OF REPRESENTATIVES

FOR THE

FIRST SESSION OF THE FIFTY-SECOND CONGRESS,

1891-'92.

IN FIFTY-THREE VOLUMES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1892.

БИБЛИОТЕКА
ГУКР
МОЛДСЕМЗЕ

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1891.

SPECIAL.—CONSULAR REPORTS.

REFRIGERATORS AND FOOD PRESERVATION

IN

FOREIGN COUNTRIES.

REPORTS FROM THE CONSULS OF THE UNITED STATES, ON THE USE OF REFRIGERATORS AND NATURAL AND MANUFACTURED ICE, FOR THE PRESERVATION OF FOOD IN THEIR SEVERAL DISTRICTS, IN ANSWER TO A CIRCULAR FROM THE DEPARTMENT OF STATE.

ISSUED FROM THE BUREAU OF STATISTICS, DEPARTMENT OF STATE. ALL REQUESTS FOR THESE REPORTS SHOULD BE ADDRESSED TO THE SECRETARY OF STATE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1890.

REFRIGERATOR CIRCULAR.

DEPARTMENT OF STATE,
Washington, November 25, 1889.

To the CONSUL OF THE UNITED STATES
At ——— ——— :

SIR: With a view to extending their trade to foreign markets, the manufacturers of refrigerators in the United States desire information in regard to the use of such articles in foreign countries, viz:

(1) Are refrigerators used in your consular district, and to what extent?
(2) Are there any peculiar features required in the construction of refrigerators for your district?
(3) Where are the refrigerators in use in your district manufactured?
(4) Sizes, formations, and prices of refrigerators in use in your district?
(5) How is ice secured in your district, and the price per 100 pounds thereof?

It is believed that many countries would adopt the American system of preserving foods and liquids, if made acquainted therewith; hence you are requested to investigate this phase of the subject as much as possible.

Where refrigerators are not in use you are requested to report upon the conditions which prevail relative to the preservation of foods and liquids, and whether the American refrigerators could not be so modified as to meet local requirements in your district.

Report, also, upon the best manner of introducing refrigerators into your district.

I am, sir, your obedient servant,

ALVEY A. ADEE,
Second Assistant Secretary.

CONTINENT OF AFRICA.

EGYPT.

REPORT BY VICE-CONSUL-GENERAL GRANT, OF CAIRO.

So-called refrigerators are in general use in the larger towns of Egypt, but are of an inferior quality, often being mere ice-boxes.

No peculiar features are required. Those in use are principally of local manufacture. They are very plain and simple, and could well be replaced by American articles, were it not for the great expense of transportation.

There are two types of refrigerators made here, one like a chest, being a simple ice-box lined with zinc, which sometimes has a zinc shelf over the ice and sometimes not. It generally contains a zinc compartment for the purpose of keeping cold water. The other has a door. Neither of them are made with double doors or linings filled with sawdust or other material, and there is therefore waste of the ice.

The prices of the two kinds mentioned vary, according to size, from 60 francs, or $12, to 90 francs, or $18, and perhaps 100 francs, or $20.

In Egypt ice is manufactured, there being two manufactories in Cairo, one in Alexandria and one in Suez. There is said to be one also in Mansourah. At different times attempts have been made to import natural ice from America and from Sweden, but they failed on account of the lower price of manufactured ice. The ice manufactured in Cairo is frozen at 50° centigrade by means of compressed air, without the aid of acids or chemicals. It is sold at 40 cents for a block weighing 44 pounds, and at proportionate rates for the half block.

There being no plans or illustrations of American refrigerators at this office it would be difficult to investigate satisfactorily the question of their successful introduction into Egypt, but there appears to be nothing to hinder the ready sale of this article here except the price, which must necessarily be high on account of the great cost of transportation. Nevertheless the founding of an establishment in Egypt by some enterprising company, for the purpose of manufacturing refrigerators on the American principle, might be feasible, as labor is cheap here. But such a company would have to seek other markets for its products besides Egypt.

Water is generally kept cool in cheap, porous earthen jars or bottles, called "goulies," manufactured in Upper Egypt, the best of them com-

ing from Keneh. The coolness is produced by the transpiration of the water through the jar and by the consequent evaporation.

Milk is preserved by boiling; butter is kept in water.

Usually every house or apartment is provided with a small safe or cupboard, perforated with holes to allow of a current of air, attached to the window-sill of the kitchen or dining-room.

LOUIS B. GRANT,
Vice-Consul-General.

UNITED STATES CONSULATE-GENERAL,
Cairo, April 21, 1890.

MADEIRA.

REPORT BY CONSUL JONES, OF FUNCHAL.

During the winter season snow and hail fall on the mountains, and this is gathered and put into caves and brought down, as required, in the early morning.

It is very expensive—worth $1.50 for what a man can carry in a basket.

Mr. Reid, the proprietor of four hotels in this city, has requested Mr. Summers-Clerk, a celebrated architect of London, to look into an American refrigerator now in use in that city, and give his opinion on same.

I should like to have some illustrations showing the refrigerator, price-list, etc.

T. C. JONES,
Consul.

UNITED STATES CONSULATE,
Funchal, January 20, 1890.

MOROCCO.

REPORT BY VICE-CONSUL STALKER, OF TANGIER.

Refrigerators are used in this consular district to a very limited extent, and there are no peculiar features required in their construction.

These were manufactured in the United States.

Sizes, formations, and prices are unknown.

Ice is imported from Gibraltar, at about $5 per 100 pounds.

ROBERT STALKER,
Vice-Consul.

UNITED STATES CONSULATE,
Tangier, January 31, 1890.

REUNION.

REPORT BY COMMERCIAL AGENT RAYEUR.

Refrigerators are not in a great demand in our country, because the people are not very fond of ice.

In June and July we have ice and snow on the top of two of our mountains; but few people mind it; nevertheless, in one of our hotels ice is used to cool beverages in summer, but on so small a scale that refrigerators have no chance to be sold here.

EDOUARD RAYEUR,
Commercial Agent.

ST. DENIS (ISLAND OF REUNION),
January 22, 1890.

SENEGAL.

REPORT BY CONSUL STRICKLAND, OF GORÉE DAKAR.

Refrigerators are used to some extent in this consular district. No peculiar features are required in their construction.

There are no refrigerators that I am aware of in this consular district except American, and as yet not many of these.

Eddy's small box-shaped refrigerator for families, price $15, is the one now mostly depended on.

Ice, until lately, has been manufactured as wanted by steam machines, but early last summer the bark *Mejunticork* brought a shipment here from Boston, which was stored at Dakar in an ice-house of wood, constructed for the purpose, and retailed at about 4½ cents per pound. It did not, however, prove a paying speculation on account of the rapid melting of the ice after it was uncovered for sale, but this difficulty is now sought to be obviated by dividing the ice-house into compartments and uncovering one at a time.

A small shipment of ice was also imported last season at St. Louis from Portland, with similar results.

There will be some demand for small-sized refrigerators for families in the future, but parties are at hand to furnish them.

PETER STRICKLAND,
Consul.

UNITED STATES CONSULATE,
Gorée-Dakar, February 4, 1890.

ZANZIBAR.

REPORT BY CONSUL PRATT.

Refrigerators are used in this consular district to a very limited extent. There are no peculiar features required in their construction.

The refrigerators in use in this district are manufactured here. No uniformity in size is observed.

Ice is chemically manufactured at a price of $3 per 100 pounds.

By the foregoing it will be observed that there can be little demand for refrigerators in this district, the high price of the manufactured ice precluding the practicability of its use as a preservative. The small local demand for ice is solely for use in cooling beverages.

SETH A. PRATT,
Consul.

UNITED STATES CONSULATE,
Zanzibar, February 10, 1890.

SOUTH AFRICA.

REPORT BY CONSUL HOLLIS, OF CAPE TOWN.

Under the present condition of the ice market here but little can be said that would encourage the manufacturers of refrigerators to incur any expense in endeavoring to introduce their wares into this market.

The refrigerators used here are mostly of American manufacture and of the medium size.

The ice in use is the artificial or chemically made, and the quotation made me to-day for a daily supply of 10 pounds was 3 cents per pound.

I have no doubt that, given ice at a reasonable price, a much larger number of refrigerators would be imported; but with ice at the price named, and an almost total failure to meet the demand on the hottest days when most needed, it is not surprising to learn that the largest houses do not average more than four or five sales a year.

I have informed a New York manufacturer of ice-machines of the condition of the business of ice manufacture here, and think it probable that he will make an improvement in this line by entering this market with the most modern machine.

In this climate ice could be used with comfort all the year round and would be under more favorable conditions.

The condition of this trade, as briefly outlined above, is applicable to the whole country.

GEO. F. HOLLIS,
Consul.

UNITED STATES CONSULATE,
Cape Town, February 15, 1890.

CONTINENT OF AMERICA.

BRITISH NORTH AMERICA.

AMHERSTBURG.

REPORT BY CONSUL TURNER.

In answer to the interrogatories contained in Department circular under date of November 25, 1889, I have the honor to report: Refrigerators are used in this consular district by all who can afford to purchase them. There are no peculiar features required in the construction. The refrigerators in use in this district are principally of American manufacture. Sizes, formation, and prices are, 3 by 5, 4 by 6, and 5 by 7 feet; average in price from $15 to $40. Ice is secured from the Detroit River and Lake Erie; price from 15 to 20 cents per 100 pounds. It is believed that the people of this consular district would adopt the American system of preserving foods and liquids, if made acquainted with them, by establishing agencies for that purpose where refrigerators are not in use. The conditions which prevail relative to the preservation of foods and liquids, are ice-boxes. American refrigerators could be so modified as to meet local requirements.

JOSIAH TURNER,
Consul.

UNITED STATES CONSULATE,
Amherstburg, January 27, 1890.

BRITISH COLUMBIA.

REPORT BY VICE-CONSUL MARVIN, OF VICTORIA.

Refrigerators are used in this consular district to a limited extent.

There are no peculiar features required. Those in use in this district are manufactured at Montreal.

The sizes are 4 by 6 feet, and the prices from $10 to $50.

Ice is secured in ice-houses, and the price thereof is 2 cents per pound.

In this consular district the heat of summer is never extreme, and therefore the demand for refrigerators is small, and those that are in use in this district are chiefly of Canadian manufacture. It would be

useless to think of introducing refrigerators into this district, as the climate during the two or three hottest months of the year is never so intense as to require them, and the duty is too high to import them.

EDGAR MARVIN,
Vice-Consul.

UNITED STATES CONSULATE,
Victoria, December 30, 1889.

CHATHAM.

REPORT BY COMMERCIAL AGENT EDDY.

Refrigerators in use in this consular district are the same as used in Michigan. They are generally manufactured in this consular district, although some are imported from the United States.

Ice in this district is secured in same manner as in Michigan, and the price per ton is $2, and 10 cents per 100 pounds.

I would also report that the American system prevails to a great extent in preserving foods and liquids in this district.

JEROME EDDY,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Chatham, Canada, January 22, 1890.

COATICOOK.

REPORT BY CONSUL ROBERTS.

Refrigerators are used in this consular district, but not to a large extent. A few of the leading families of the vicinity have them, and some of the grocers and meat dealers make use of them at their places of business.

No peculiar features are required. Those in use are manufactured in Canada. The sizes and formations are, I find, similar to those of the refrigerators in use in the New England States. A common size here is 18 by 36 inches. The prices of refrigerators in this vicinity are from $10 to $18.

In this consular district ice is secured by the use of tools similar in character to those used for the same purpose in the New England States. The price of ice to the consumer is 20 cents per 100 pounds.

On account of the usually short duration of the warm or summer season of each year in this portion of the Dominion, and on account, also, of the consequent small demand for the use of ice in the preservation of foods and liquids, this consular district, in my judgment, does not present a very inviting field for the introduction of American refrigera-

tors. The best manner of introducing them, however, would be, I believe, for the manufacturer to procure a hardware dealer in Coaticook, and also one in Rock Island (in the township of Stanstead), to act as agents for their sale.

FRANK W. ROBERTS,
Consul.

UNITED STATES CONSULATE,
Coaticook, January 13, 1890.

FORT ERIE.

REPORT BY CONSUL WHELAN.

In the consular district of Fort Erie refrigerators are pretty generally used, and about to the same extent, comparatively, and under like conditions, as in the States bordering on the Great Lakes. The features and styles embodied in the refrigerators manufactured and used in those States would entirely answer the requirements of this consular district. Those used here are manufactured in Brantford and other parts of the province of Ontario

The following tables give the sizes, description, and prices of the refrigerators used here.

Description.	Length.	Depth.	Height.	Price.
	Inches.	*Inches.*	*Inches.*	
Wood lined, bronze trimmings, oak-grained, casters	28	18	42	$11.00
Zinc lined, new patent latch, casters, thick wall	82	18	42	14.00
Zinc lined, hard wood, thick walls, bronze trimmings, casters	26	17	40	15.00
Do	28	18	42	17.00
Do	30	19	44	19.00
Do	33	21	46	21.00
Zinc lined, bronze trimmings, locks and hinges, casters	34	20	46	24.50
Do	41	22	48	28.50
Do	47	23	50	33.50
Ice-chest, hard wood	30	22	30	10.00
Do	34	23	31	11.00
Do	40	25	32	13.00
Counter refrigerators: Ice-chamber, water-cooler, and tap; lower part, under ice-chamber has glass front ends, and forms a show-case for exhibition of butter or other provisions needing ice	24	24	27	13.00

In all these refrigerators, except the chest, the ice-chamber is on top.

The dealers get 25 per cent. off these prices, and the Canadian duty on refrigerators is 35 per cent.

Query: Can United States manufacturers compete?

Ice is secured here in the ordinary ice-house, just as in the United States, and is sold by the ton for from $2.50 to $3.00. It is retailed at the rate of 25 to 30 cents per 100 pounds.

JAMES WHELAN,
Consul.

UNITED STATES CONSULATE,
Fort Erie, February 10, 1890.

GASPÉ BASIN.

REPORT BY CONSUL DICKSON.

Refrigerators are almost an unheard-of piece of furniture in this district; even the stores and hotels do not use them.

Snow takes the place of ice in this district; the stores, hotels, and about all of the inhabitants have snow-houses on their premises.

The fresh fish that is shipped from here to the United States is packed in snow, which is deemed superior to ice, as it keeps the fish cool but does not freeze them.

There is no ice put up in this district to speak of; just a small amount, for the use of steamers that run here during the summer months.

In regard to the last clause of this circular, to report upon the best manner of introducing refrigerators into this district, I am unable to offer any encouragement in this line at present, for there are no cities or large towns in this district; the villages number from 200 to 500 inhabitants each. There is no such thing as an ice-cart delivering ice from house to house in this district.

ALMAR F. DICKSON,
Consul.

UNITED STATES CONSULATE,
Gaspé Basin, January, 1890.

LONDON.

REPORT BY COMMERCIAL AGENT LEONARD.

Upon diligent inquiry I learn that refrigerators are used only in cities and larger towns; there is rarely any demand for them in the country, owing, it is alleged, to the fact that most or quite all the farmers are supplied with good cellars and out spring-houses, with cool water running through the latter. There are no striking or peculiar features in construction different from those manufactured in the United States except in the matter of finish. Dealers say our refrigerators are more tastefully finished. Nearly, if not all, as far as I am able to learn, now being sold here are of home production. Formerly the Baldwin ice-chest, of Vermont, was sold in this market. A few also from some Buffalo manufacturer were sold here. None of either are now kept in stock, the whole trade being supplied by home manufacture. In size they correspond with those manufactured in the United States for domestic purposes. Some contain ice only on the top, others contain ice both top and body of chest ranging in price from $10 to $20, according to size and finish.

Ice is secured here in great abundance. It is taken from the north

branch of the Thames River and from spring ponds in the immediate vicinity of the city. The latter is much purer and better and sells at 12½ cents per 100 pounds.

I have made particular inquiry as to the possibility of introducing refrigerators where not now in use. I am told that it would be difficult for the reason already given. The farmers depend upon their cool cellars and out spring-houses. I will continue my investigations, and if I find anything of special note will report it promptly. I am inclined to think, from the favorable expressions made of American manufactures of ice-chests in their finish, that with proper effort there might be some increase of trade and preference given to our productions. I can not promise much with the home manufacturers looking up the trade, pressing sales, large and small, whenever they can.

H. Z. LEONARD,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
London, January 16, 1890.

KINGSTON.

REPORT BY CONSUL TWITCHELL.

Refrigerators are in general use in this consular district among the wealthy class of citizens. No peculiar features are required in their construction. Some of the refrigerators used are manufactured here; the largest proportion are imported from the United States; they are similar to those in New York State; price from $8 to $35.

Ice is cut from the harbor during the winter, and is delivered to customers at about 25 cents per 100 pounds.

WM. TWITCHELL,
Consul.

UNITED STATES CONSULATE,
Kingston, January 17, 1890.

MANITOBA.

REPORT BY CONSUL TAYLOR, OF WINNIPEG.

On account of the northern climate, refrigerators are used to limited extent only in this district in proportion to population. In the country, cellars where water is congealed during winter to a considerable depth and closed during summer are a very convenient substitute.

Ordinary patterns and grades of refrigerators as used in United States are occasionally manufactured here, but are mostly brought from Toronto, Brantford, and London in Eastern Canada. Those generally

in use are of the following dimensions: 41 by 33 by 21 inches, price $18; 41 by 40 by 21 inches, $20; 48 by 46 by 21 inches, $25.

The duty by the Canadian tariff on refrigerators, classified as "furniture," is 35 per cent. ad valorem.

Ice is readily secured in all parts of Manitoba and elsewhere in this consular district, price $1 per ton; delivered and distributed in summer by ice companies to families at $5 per season of five months at 10 pounds daily, and larger quantities at less rates.

JAMES W. TAYLOR,
Consul.

UNITED STATES CONSULATE,
Winnipeg, June 14, 1890.

MONTREAL.

REPORT BY CONSUL-GENERAL KNAPP.

Refrigerators are used in this consular district, their use, however, being mostly confined to the cities and villages. As to just what extent they are used it is impossible to state. The climate here during the greater part of the year is so cold that refrigerators are not in such demand as they are in a warmer climate. Still they are used here to a considerable extent and their use is increasing.

I am unable to find that there are any peculiar features required in their construction.

The refrigerators used here are mostly manufactured in Montreal, Ottawa, and Brantford, Canada.

The principal manufacturers in Montreal are George W. Reed and Joseph E. Barill. Some refrigerators are also imported from the United States, those so imported being manufactured principally by the Jewett Manufacturing Company, Buffalo, N. Y., and by the Baldwin Manufacturing Company, Burlington, Vt.

The refrigerator most in use here is the North Star refrigerator, manufactured in this city.

To secure an equable cool temperature throughout this refrigerator the ice compartment is placed in the top, thus allowing the cold air to descend from the ice.

To effect a thorough circulation as well as ventilation, a current of air is created and passed through by means of ventilators on the sides. (and which are used to regulate this at pleasure) into the air-chamber, from whence it enters into and circulates throughout the compartments, making its exit on the opposite side to which it enters through similar air-chambers and ventilators.

The shelves are made of galvanized-iron wire, which does not rust, and the rack is covered with zinc. This last not only protects the bot-

tom of the ice-box but also serves to keep the ice free from its meltings, and economizes.

This refrigerator is manufactured in different sizes, with prices varying according to size.

Width.	Depth.	Height.	Price.
Inches.	*Inches.*	*Inches.*	
35	22	45	$23.00
38	23	47	26.00
41	24	49	30.00
44	25	51	35.00
48	26	53	40.00

The North Star refrigerator is, as stated above, the one principally used in this district; other refrigerators used to some extent do not vary materially from the one above described in sizes and prices, and while in formation they may differ somewhat, they are of ordinary construction, with no peculiar features characterizing their formation.

Ice is secured in this consular district principally from the rivers St. Lawrence and Richelieu. The ice secured by ice companies is furnished to customers at 29 cents per 100 pounds.

CHAS. L. KNAPP,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Montreal, February 6, 1890.

NOVA SCOTIA.

REPORT BY CONSUL-GENERAL FRYE, OF HALIFAX.

Refrigerators are in use in Nova Scotia to a moderate extent. There are no peculiar features required in their construction for this province. Most of the refrigerators sold in Nova Scotia are manufactured in some part of Canada—some in this province and some in Ontario. A few are or have been imported from the United States, and they are said to be better finished than the Canadian make; but owing to the Canadian duty, which is 30 per cent. ad valorem, they can not be sold at a profit in competition with those manufactured in Canada.

The sizes most in use for domestic purposes are: Width, 2 feet 6 inches; height, 44 inches. They are similar in arrangement and appearance to the American refrigerators, different styles being used, and are sold for about the same price that the American article sells for in the United States.

Ice is easily secured in winter in this country wherever there are streams or fresh-water lakes, which are abundant. The ordinary price of ice, per ton, is about $1.50. This season, owing to the greater demand abroad, the price is about $2.50. By the 100 pounds it is sold for 25

cents. Families using moderate quantities during the warmer seasons of the year, obtain it for from $3 to $6 per season, according to the quantity used.

Ice is stored to considerable extent in winter both for shipment and for domestic use. Some families who do not use the refrigerators have small houses or large closets, in which a supply is kept for daily use in summer. I doubt if these store-rooms or closets are constructed on modern or improved plans. In one of the meat-markets in Halifax, however, a large apartment is now being constructed by a professional builder of refrigerators from Boston, who has constructed several of them in other parts of the Dominion. It will cost about $1,500, and will be a decided improvement upon anything of its kind in this city, if not in this province.

It is not probable that under the present Canadian tariff American refrigerators can be successfully sold here, unless the manufacturers can furnish them cheaper than at their present prices. To find a market the refrigerators must be of better appearance, finish, and quality, and as cheap, or nearly as cheap, as the Canadian article. Purchasers unacquainted with refrigerators can not always judge what kinds possess the best preserving qualities, and are apt to buy the cheaper article, provided it looks well and appears to be convenient in its arrangements. The only way, therefore, to find a market here for the American refrigerator would seem to be to place the very best article in the market at the lowest price, and to advertise it liberally. In the hands of enterprising and competent agents they might, and I believe would, find some sale here. Like many other luxuries the refrigerator becomes a necessity, as people become accustomed to its use and learn its value.

WAKEFIELD G. FRYE,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Halifax, April 3, 1890.

OTTAWA.

REPORT BY CONSUL-GENERAL LAY.

Refrigerators are largely used in this consular district for domestic purposes and by butchers, brewers, pork-packers, green grocers, hotels, restaurants, etc.

Those in use are mostly box-shaped, with sides of wood, having spaces filled with non-conducting material and dead air spaces. The ice-box is on top or on the side, and the air is drawn through ventilators, passing over the ice and descending to the storage chamber. One style in rather general use here is the "Hauralean" patent, which is similar to the American "Lorillard" patent. They are manufactured for domestic purposes in the principal cities, Toronto and Ottawa. Cold-storage

houses are put up and used in Morrisburg, Iroquois, Prescott, Brockville, and Kingston, usually for the storage of butter and eggs, meats, etc., where ice is cheap and from whence large shipments are made.

The sizes, formations, and prices of the refrigerators in use are as follows: 36 by 32 by 18 inches, ash, $20; 42 by 32 by 18 inches, ash, $25; 48 by 34 by 21 inches, ash, $30; 48 by 40 by 27 inches, ash, $40; 72 by 54 by 30 inches, ash, $60.

The above is the ordinary domestic refrigerator, box-shaped. Special sizes are made for hotels, restaurants, etc.

Ice is usually sawn into blocks 3 feet long. It is then packed in large ice-houses; price, put in, from 35 to 50 cents per ton, according to distance of haul. Price of ice at retail, in summer, about 40 cents per 100 pounds.

Comparing the American system with the Canadian, it is claimed here that Canada has an equally good one. But it can hardly be said that perfection has been attained in the consumption of ice, in the even distribution of air, in the carrying off of noxious gases generated by articles of food, or in the perfect dryness of the air. There have been about fifteen Canadian patents issued for refrigerators within the past ten years.

Refrigerators are used very universally except in the country districts. Nearly every household goods dealer is an agent for some refrigerator, and no one style possesses sufficient merit to become universally adopted.

The best manner of introducing refrigerators into this district would be to have reliable traveling agents to visit important cities and towns and select household dealers, like the companies do here, and give them a liberal commission for a time to sell them; also, to show the refrigerators at the agricultural fairs which are held, annually, in the fall; also, by a judicious system of advertising.

RICHARD G. LAY,
Consul-General.

UNITED STATES CONSULATE GENERAL,
Ottawa, February 6, 1890.

PORT HOPE.

REPORT BY COMMERCIAL AGENT SHAFFER.

Refrigerators are almost universally used in hotels, butchers' stalls, and private houses. No peculiar features required in construction, except those mentioned below.

The refrigerators in use in this district are manufactured in Toronto and in Michigan. Hotels and private houses use the Leonard refrigerator, for the most part, manufactured in Michigan.

The sizes are 8 by 10 and 12 feet in height, according to the business for which they are required.

Butchers use 12 by 14 by 14 feet high; they are double lined with felt paper between the boards.

Fruiterers and fish dealers use a smaller size with an outer and an inner "skin" 2 inches apart, and this space is filled with charcoal; a part of the top portion is reserved for ice, and on the sides there are spaces for the cold air from the ice-chamber to enter the refrigerator; and in the rear there is a warm air-chamber for carrying off the warm air.

The cost is from $250 to $600.

Average sizes, 27 by 18 by 42 inches, $16; 30 by 20 by 45 inches, $22; 36 by 21 by 48 inches, $30; 40 by 24 by 50 inches, $40; 43 by 26 by 60 inches, $50; 48 by 25 by 45 inches (drawing-room style), $75.

The ice is secured from the rivers and lakes by cutting it with a cross-cut saw into blocks 2½ feet long and 1½ feet wide. It costs the consumer 50 cents per 100 pounds.

Generally, I think the people are familiar, in this district, with the various kinds of American refrigerators, and if they do not adopt them it will not be from ignorance of their superiority.

LUTHER M. SHAFFER,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Port Hope, January 30, 1889.

PORT ROWAN.

REPORT BY COMMERCIAL AGENT SCHOOLEY.

Refrigerators are in use in this consular district only to a limited extent. There are no peculiar features required in the construction. They are manufactured principally in Toronto, Hamilton, and Brantford.

Sizes and prices are as follows: From 24 to 40 inches in length, 18 to 20 inches in depth, 27 to 45 inches in height; generally of square design; from $11 to $30 for ordinary house use.

Ice in this district is cut from ponds. The price is $1 per load, delivered in ice-house, each load containing about 1½ tons. It is generally retailed to customers for the season, ranging from $2 to $15 and $25, according to the quantity used.

I may here add that many private houses have their own ice-houses and they are greatly utilized. In many cases ice-chests, simply made of wood and lined with zinc, are largely used. As there are only villages and towns, there being no cities in my district, refrigerators are not used to such an extent as in the cities. A good deal of dependence is also placed in the cellars, they being built with a due regard to the preservation of foods and liquids.

As to introducing refrigerators into this district, the greatest drawback is regarding prices; there being also a duty of 35 per cent. which makes it almost prohibitive.

R. H. SCHOOLEY,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Port Rowan, Januarg 21, 1890.

PORT STANLEY AND ST. THOMAS.

REPORT BY CONSUL QUIGGLE.

Refrigerators are used in this consular district to about the same extent as in similarly situated parts of the United States. There are no peculiar features required in their construction other than those ordinarily found in American-made refrigerators. They are manufactured at Toronto, London, Brantford, and Harriston, in the Province of Ontario; sizes and formations are about the same as standard American refrigerators. Prices range from about $10 to $25, retail. It is seldom that any are sold at a higher figure than the latter.

The mode of securing ice is so obvious in this northern latitude as to require no explanation. The price of ice in the summer season is usually from 12 to 15 cents per 100 pounds.

The best manner of introducing refrigerators into this district would be by furnishing dealers with descriptive catalogues and placing the prices so low, and making the discounts so liberal, that they could afford to pay the Canadian duty of 35 per cent. ad valorem and sell them as cheap as those of domestic manufacture.

JAMES C. QUIGGLE,
Consul.

UNITED STATES CONSULATE,
Port Stanley and St. Thomas, January 17, 1890.

ST. HYACINTHE.

REPORT BY COMMERCIAL AGENT MOORE.

Only the smaller sizes of refrigerators are used here by private families. In stores large ice-boxes, constructed like those you would find in every meat or provision store in the United States, are not in general use; if there are any, they are constructed after their own plans and are merely large boxes.

In the market here, where meats are sold on every Saturday, there are no ice-boxes or cold storage. The butchers take their meat which is unsold and put it in the large cold-storage rooms (of an American firm

of egg packers here), made after plans by Mixer & Co., American refrigerator makers. They are charged one-half cent per pound for this privilege and keep their meat there until the next market day.

There are no peculiar features required in the construction of refrigerators for this district. Those in use are manufactured in the province of Ontario.

The prices, etc., given here are taken from the price-list of the manufacturers of refrigerators on sale here, Messrs. Gould & Knowles, Brantford, Ontario. The measurement is the outside measurement.

Description.	Length.	Depth.	Height.	Price.	Shipping weight.
	Inches.	*Inches.*	*Inches.*		*Pounds.*
Cheap grade	28	18	42	$10.00	160
Medium grade	26	17	40	14.00	140
Do	28	18	42	16.00	160
Do	30	19	44	18.00	175
Do	33	21	46	20.00	200
Best grade	34	20	46	23.00	215
Do	41	22	48	17.00	255
Do	47	23	50	32.00	318
Ice-chests	30	22	30	9.00	146
Do	34	23	31	10.00	160
Do	40	25	32	12.00	180
Counter refrigerator, glass side for show-case	24	24	27	12.00	146

Ice is cut from the river on which the town is situated; nearly every person has his own ice-house, which he fills himself.

It is never sold by the pound, but ice men charge $8 for the season of five months, delivering 20 pounds daily.

The best manner to introduce refrigerators would be to place them in the hands of some merchant here, or else send a commercial traveler, and by judicious advertising.

THOMAS EWING MOORE,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
St. Hyacinthe, February 3, 1890.

ST. JOHNS, QUEBEC.

REPORT BY CONSUL FISK.

Refrigerators are generally used in this district. No peculiar features required. A refrigerator that is good for New England would be good for this district.

Those in use here are manufactured at Brantford and London, Ontario, Montreal, Quebec, and to some extent at Burlington, Vt.

The formations are quite like the refrigerators in common use in New England. The ice compartment is generally in the top. Single and double doors are used, with zinc or wood for lining. In some, to effect a thorough circulation and ventilation (as claimed), a current of air is

created and passed through by means of ventilators on the sides into the air-chamber, from whence it enters and circulates throughout the compartments.

Prices.

	Length.	Depth.	Height.	Price.
	Inches.	*Inches.*	*Inches.*	
No. 1	34	20	46	$23.00
No. 2	41	22	48	27.00
No 3	47	23	50	32.00
No. 10	60	28	68	45.00

Ice is secured from the streams. The price is about 20 cents per 100 pounds.

H. C. FISK,
Consul.

UNITED STATES CONSULATE,
St. John's, Quebec, February 10, 1890.

ST. STEPHEN.

REPORT BY CONSUL GOODNOW.

Very few refrigerators are used in this district, and those in private families, they are of all kinds, sizes, and of local manufacture; there is no demand at present for them.

Ice is cut on this (St. Croix) river 2 miles above the town, hauled here by teams, and stored at an expense of 50 cents per ton; in summer time it is sold for 50 cents per 100 pounds.

EDWARD C. GOODNOW,
Consul.

UNITED STATES CONSULATE,
St. Stephen, January 30, 1890.

SHERBROOKE.

REPORT BY CONSUL WHITE.

Refrigerators are used in this consular district very generally, more perhaps than would be natural to suppose in a latitude as far north as this is, and where there is but very little warm weather compared with other sections of the country.

There are no peculiar features required in their construction. It is safe to say that fully 75 per cent. of them are manufactured in the United States.

As an invariable rule, the size and formation consist of the ordinary size and style in general use by private families, hotel proprietors, dairy

and market men throughout the eastern and northern part of the United States, which are so well known that I deem it inexpedient and unnecessary to enter into a detailed account and description of the construction of these ordinary house and market refrigerators.

In some countries where there is an extremely warm climate the year round, it has been proved and demonstrated that ice can be manufactured by an artificial process much cheaper than to transport it from colder countries, but in a country like this, where, during the winter months, the temperature is so cold that the mercury ranges at times as low as 45° below zero, there seems to be no occasion to resort to artificial means to secure ice in this immediate locality. It is cut and taken from the rivers, ponds, and lakes in this localty at a cost of about 40 or 50 cents per ton and preserved in ordinary ice-houses.

Ice-dealers furnish ordinary private families for $5 a season and charge hotel and market men and other parties using a large quantity at the rate of $2.50 or $3.00 a ton.

D. M. WHITE,
Consul.

UNITED STATES CONSULATE,
Sherbrooke, March 13, 1890.

THREE RIVERS.

REPORT BY CONSUL SMITH.

Refrigerators are in general use in this consular district.

So far as I can learn there are no peculiar features in their construction. They are manufactured in this city.

They are of all sizes; prices range from $18 to $50.

While those in use here are generally inferior to those manufactured in the United States, the climate, even in mid-summer, is so cool and the people are so poor, that I can offer no encouragement to American makers to attempt the introduction of their wares.

NICHOLAS SMITH,
Consul.

UNITED STATES CONSULATE,
Three Rivers, December 2, 1889.

MEXICO.

GUAYMAS.

REPORT BY CONSUL WILLARD.

Refrigerators are used to a very limited extent in this consular district. The few that are used are of American manufacture, but the whole number imported for the past five years will not exceed thirty.

There is no system of preserving food in this part of Mexico beyond that practiced from the early days of the settlement of this coast, viz: drying in the open air the flesh of animals, the atmosphere being such that in three days' exposure to the sun it is perfectly dried. The same is then made into bales or packages and will keep from one to two years.

The ice which we have in this part of Mexico is made artificially; there are but two ice-machines in this consular district; one at Guaymas of the capacity of 5 tons daily. The consumption in the summer months, from June to November, is 3 tons per day. The ice-machine at Hermosillo (capital of Sonora) has the same capacity, and the consumption is about the same as at Guaymas. No ice is imported from the United States as a regular business. Price in Guaymas per pound 2½ cents; in large quantities, 1½ cents.

The preservation of liquids has not been attempted.

Regarding the best manner of introducing refrigerators into this district, I am unable to give a clear idea; the people still pursue the old-time custom of their forefathers, and although this consular district borders on the United States, with daily railway communication, no change, excepting to a limited extent, has been made in the manner of living, and no new system of preserving food and liquids attempted. There are no canning establishments for the preservation of either beef or fish in this consular district.

A. WILLARD,
Consul.

UNITED STATES CONSULATE,
Guaymas, March 1, 1890.

LA PAZ.

REPORT BY CONSUL VIOSCA.

While this country is so utterly unprovided with the facilities for procuring ice enough during summer to satiate the craving appetite of one-third of its consumers, and that at the enormous price of from 12

to 25 cents per pound at which it is sold, when any of it from across the Gulf has reached the market, it becomes thus impossible to make a report of any utility to the manufacturers on the refrigerator subject.

JAS. VIOSCA,
Consul.

UNITED STATES CONSULATE,
La Paz, February 1, 1890.

PASO DEL NORTE.

REPORT BY CONSUL SAMPSON.

Very few refrigerators are used in this consular district.

Ice is secured from the Artificial Ice Company of El Paso, Tex. Price, 75 cents per 100 pounds.

A. J. SAMPSON,
Consul.

UNITED STATES CONSULATE,
Paso del Norte, February 20, 1890.

TUXPAN.

There being neither ice nor machines for its manufacture in this district, refrigerators could not be sold in this market.

JOHN DRAYTON,
Consul.

UNITED STATES CONSULATE,
Tuxpan, January 18, 1890

CENTRAL AMERICA.

COSTA RICA.

REPORT BY CONSUL MACKEY, OF SAN JOSÉ.

Refrigerators are used in Costa Rica to but a limited extent, their use being confined to the capital, San José, and the two ports Punta Arenas and Limon.

The latter places are small, neither exceeding more than 2,500 inhabitants. San José has a population of 25,000, but the standard of comfort is not sufficiently high to bring refrigerators into general use. They are used principally in the drinking saloons and retail grocery stores of the towns mentioned.

There are no peculiar features required in their construction for this district.

Those in use are manufactured in New York or San José.

Only the smaller sizes are used, and those of the simplest form. Those manufactured here hold, as a rule, 5 pounds of ice; those imported are made to hold from 25 to 30 pounds. The cost of the former is $10, United States currency; of the latter, about double that sum.

There are ice factories in San José and Punta Arenas, and consumers are supplied daily with the ice required at a cost of 1½ cents (United States currency) per pound.

My reply to the Department's circular is brief, for the reason that the trade here in refrigerators is insignificant, and likely to continue unimportant, on account of climatic and social conditions.

BECKFORD MACKEY,
Consul.

UNITED STATES CONSULATE,
San José, February 10, 1890.

NICARAGUA.

BLUEFIELDS.

REPORT BY CONSULAR AGENT SIMMONS.

"No" and "none" are the only replies I can make to interrogatories 1, 2, 3, 4, and 5 of the refrigerator circular.

During the past two years the writer has industriously sought, for his personal needs, an apparatus for the preservation of foods and liquids, one that should cheaply maintain a sufficiently low temperature, and

not necessarily for production of ice, for which the demand is not enough to warrant the expense of machinery. To the very many letters of inquiry sent to all parts of the United States circulars only were received in reply, representing machines for making ice; expensive, involving employment of steam-engines, and skilled labor to conduct them.

One ton of ice per week would at present fully supply all demands, and its price must not exceed 5 cents (*soles*) per pound to insure the sale of so much. What is wanted are refrigerating apparatus for the preservation of meats, etc., and cheap enough to meet private needs, machines that will maintain a uniform temperature of 38° to 40° Fahr. One such on a large scale would meet all town requirements and serve to promote the sale of meats, poultry, etc., of American importations. Facilities for the introduction of everything needed are furnished by steam lines from the ports of New Orleans, Savannah, Philadelphia, and New York.

JNO. H. SIMMONS,
Consular Agent.

U. S. CONSULAR AGENCY,
Bluefields, January 25, 1890.

MANAGUA.

REPORT BY CONSUL WILLS.

Refrigerators are used to such a limited extent in my consular district that I can not say they are used at all.

The ice company brought in a few refrigerators, with the materials for their factory, duty free; finding no demand for them, they were put upon the market below cost. The price paid was $21; they were offered at $15, but not sold.

Another gentleman has lately imported fifteen, costing from $3 to $15 each. He finds no sale for them.

They are manufactured by Macy & Co., New York.

Ice is manufactured only in Managua, and shipped to the different towns. The wholesale price at the factory is $2.50 per 100 pounds, but it is retailed by special agents at 5 cents a pound. Parties using ice buy a pound at a time, generally before each meal.

Perishable goods are purchased only in sufficient quantities for the day. The markets are open every day, including Sundays.

CHAS. H. WILLS,
Consul.

UNITED STATES CONSULATE,
Managua, April 15, 1890.

SOUTH AMERICA.

ARGENTINE REPUBLIC.

REPORT BY CONSUL BAKER, OF BUENOS AYRES.

I am in receipt of the circular of the Department of State asking certain information in regard to the use of refrigerators in the Argentine Republic, with a view to extending the trade of American manufacturers of such articles in this country.

In reply I have to state that the people of this Republic fully appreciate the value and convenience of the American refrigerators, and for a number of years, ever since the manufacture of artificial ice was commenced in this country, these articles have not only been imported here, but they have found a very ready and increasing sale. Now, not only are they used by hotels, cafés, eating-houses, *confiterias*, and drinking saloons generally, but in all the dwelling-houses of the wealthier classes.

I know of no particular features which are required in their construction to meet the tastes of this community, but you will see in use all the various shapes and sizes, from the mere ice-box to those which have the pretentions of a sideboard. As, however, ice is an expensive article of luxury, I suppose those whose construction requires the smallest quantity and least consumption of ice would be preferred.

There may be some few refrigerators imported from other countries, but the great bulk of those on sale here are from the United States.

In regard to sizes, formations, and prices, there is nothing that I can say further than that these depend on the requirements, the tastes, and the means of those who purchase them, just as is the case in the United States.

The great drawback to the universal use of refrigerators in the Argentine Republic is the fact that there is no natural ice here, and no importations from northern latitudes. All the ice used is manufactured; and while the quantity is every year growing larger and the quality is equally being improved, yet the expense is so great, other things being considered, that it is only those with somewhat plethoric purses who can indulge in its general use. Two years ago the price was 90 cents per 25 pounds, but, owing to increased facilities in its manufacture, you can now buy a very good quality for from 2 to 3 cents per pound for large quantities. At retail, from the groceries, it sells for 5 to 8 cents per pound, according to the demand. These prices are in Argentine paper money, which, reduced to gold, would make the price of ice about 1 cent per pound for large quantities, and 2½ to 4 cents per pound at retail, estimated in United States coin.

A few years ago the attempt was made to import ice from the United States to Buenos Ayres, but it proved to be a failure owing to the fact that sea-going vessels at that time were obliged to anchor about 8 miles from the shore and have their cargoes transferred to lighters; so that with such exposure under a fervent sunshine ice cargoes melted about as rapidly as they were delivered. But since then a great change has been effected in the handling of cargoes here. Now Buenos Ayres has a good and convenient harbor, where vessels discharge alongside of commodious wharves or docks without delay and without trouble; and it seems to me, if parties should first make arrangements for ice deposits on these docks, that it would be a paying business to import ice to Buenos Ayres from the United States. I think there is no doubt that it could be delivered from the United States much cheaper than it can be manufactured here. Thus, with its more general use owing to greater cheapness, there would be an increased demand for American refrigerators.

E. L. BAKER,
Consul.

UNITED STATES CONSULATE,
Buenos Ayres, February 12, 1890.

BOLIVIA.

REPORT BY CONSUL-GENERAL ANDERSON, OF LA PAZ.

My personal knowledge of the demand for refrigerators is confined to the department of La Paz, in which I have my official residence, not having visited either of the other seven departments of Bolivia, viz: Cochabamba, Potosi, Chuquisaca, Oruro, Tarija, Beni, and Santa Cruz. With the exception of the province of Fungas, lying in the northeast of this department and beyond the great Cordillera range, and a portion of the province of Cercada, lying south of this city some 8 leagues, and in the low valleys of the La Paz River, there is no demand whatever for refrigerators in the department of La Paz, owing to the favorable climatic conditions resulting from its varying altitudes of from 10,000 to 13,000 feet.

Here, as well as throughout the great departments of Potosi, embracing nine provinces, and Oruro, embracing three provinces, foods and liquids are kept in perfect preservation for from five to eight days in summer and from eight to twelve days in winter, by simply exposing them to the fresh air. The three departments to which I refer fall within the chief mountain districts of Bolivia, and embrace the great body of the population of the Republic.

The departments of Beni and Santa Cruz, lying still beyond the province of Fungas, have a climate similar to that of Fungas, but are so remotely situated and sparsely settled that neither offers an inviting field for the line of American goods referred to, although climatic conditions are favorable to their introduction. The departments of Coch-

abamba and Tarija embrace within their extensive limits a large number of low, warm, and exceedingly rich valleys, the products of which soon perish, as I am informed, for want of some adequate system for their preservation. The remaining department of Chuquisaca has a temperate climate as a rule.

The rural portion of this department is sparsely settled, the great bulk of the population living in Sucre, not only the capital of the department but of the Republic. It is apparent, therefore, from what I have here stated, that there is no general demand for refrigerators in this country; that the demand therefor, so far as the climate is concerned, is confined to the warm districts I have enumerated. The introduction of refrigerators into these districts is, in my judgment, an experiment worth trying.

A vast amount of the products of these sections of the country perish for lack of the American system of preserving foods and liquids. If, however, the manufacturers of refrigerators in the United States undertake this experiment they must do it in the light of the fact that the Indians are the producing class in this country, and that the introduction of modern appliances to take the place of their primitive methods of labor is regarded by them, as a rule, as an innovation not to be encouraged.

As to the manner of securing ice and its price per hundred pounds, I have to report that the supply of ice here at all seasons of the year is unlimited. The famous Illimani, which reaches an altitude of more than 23,000 feet, and other great peaks of the Andes system are not only perpetually covered with snow, but abound in solid beds and columns of ice as well.

The Indians climb to these mountain heights and, cutting the ice into blocks, lash them across the backs of llamas, and, with these celebrated burden-bearers of the Upper Andes, each carrying not exceeding 100 pounds, the limit of their ability as pack-animals, they descend, as sure of foot as the llamas themselves, to the ice markets of the country, where they sell it at from 20 to 40 cents per 100 pounds.

T. H. ANDERSON,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
La Paz, March 15, 1890.

BRAZIL.

RIO DE JANEIRO.

REPORT BY CONSUL-GENERAL DOOKERY.

Replying to the Department's circular of date November 25, 1889, asking information in regard to the use of refrigerators in this consular district, I beg to report that after careful investigation I find that they

are now used in this city to a limited extent. The demand, however, is slowly increasing each year, and 200 to 300 will probably be sold this season. Those in use are principally imported from the United States, are small, cheaply constructed, and sell here for $10 to $50. No higher-priced article can now be sold here, but as the demand increases more costly ones can be introduced. Ice is manufactured here and retailed at 2½ to 3½ cents per pound. As a local company secured and now holds valuable concessions and exclusive privileges for cold-air preservation which are not now in use, the chances for the successful introduction of any other method are not good at present.

Up to now, the supply of articles of food has been for the day only, but, with facilities to keep it, a change of custom may reasonably be looked for. Ice having been put on the market at a figure placing it within the reach of the people, from being a luxury it will come into general use, and with that will come the increased demand for refrigerators.

My conclusions are that a market can be opened here for the successful introduction of American refrigerators. To do so will require a careful study on the part of our manufacturers to produce such goods as will suit the trade. A large stock of the manufactured article should be brought here and considerable money spent in advertising and pushing the sale. I believe the result will come slowly, but very satisfactorily.

I shall refer more fully in a general dispatch to the necessity of our manufacturers becoming more thoroughly acquainted with and adapting their products to the wants of this market if they would enter into competition with the English and Germans. A splendid opportunity is now presented.

O. H. DOCKERY,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Rio de Janerio, February 15, 1890.

BAHIA.

REPORT BY CONSUL BURKE.

As to information concerning refrigerators, as called for in the circular dated November 25, 1889, I have the honor to say but very little can be given, as the use of this article in this place is confined to the hotels and a few restaurants. Not a half dozen were imported during the past year. They are almost an unknown quantity in private houses. One may be found here and there, but they are so little used that hardware merchants do not keep them in stock. In one of the large hardware stores I found one, which the merchant had imported on order from England. This and another one made up his entire importation of refrigerators for the year 1889. It was a small one, perhaps 2½ feet

square; retail price, 40 milreis ($21.84); constructed much the same as American refrigerators of the same size. It was lined with zinc inside, with a place for depositing the ice, and shelves that were movable, making the space between them larger or smaller according to size of the articles placed within.

I saw one of a German make, size about 4 feet in height, 4 in length, and 2½ in breadth. At the top of this was the ice-chest, extending through its length and breadth dimensions and about 6 inches in depth. Underneath this ice-chest were the slides and the shelves, the shelves being movable. Below the ice-chest are two partitions, or, rather, two compartments, with a partition running up and down through the center of the refrigerator. In this partition is a faucet to draw the water from the ice-box. The interior of the refrigerator is lined with zinc. The cost of this refrigerator, when exchange was high, was 120 milreis ($65.52), laid down here in Bahia. The freight on it was 28 milreis ($15.29), and the duty 38 milreis ($20.77), together with other expenses, making, as mentioned above, 120 milreis all told. England and Germany furnished the very few that are here.

The prevailing opinion among Brazilians is that it is unhealthy and injurious to use ice in this climate. Even many foreigners hold the same opinion and rarely use ice. Those families that use ice buy it late in the afternoon as the ice-cart goes through the city, place the ice bought in a small box of saw-dust when the ice is used at dinner, which takes place from 6.30 to 8 p. m.

From one to three kilos is the quantity purchased by those families that use it. By families it is not used at all to preserve foods.

As meats can be bought at any time of the day and fruit also, no more of anything is purchased than is required for the day; therefore in such cases the refrigerator is dispensed with. Canned goods are also very largely used.

Ice is very expensive, selling at 200 reis, about 10 cents, per kilo, or say 5 cents per pound.

Yet I do not think it is the price of the ice that prevents people from using it more extensively, but because its use, as I said, is regarded as being unhealthy and injurious. But perhaps the chief reason why families do not use refrigerators is because they never have used them and can not appreciate how good a thing it is to have them. As far as I can learn no special effort has ever been made to introduce them and merchants sent for them only on order simply, because there has not been nor is there to-day any demand for them.

The first thing to do if any business is expected is to create a demand for them. This can be done only, it seems to me, by showing families how good, useful, and necessary a thing a refrigerator is.

If this could be done and ice drop one-half in price, there would be a sale for refrigerators.

And I do not know of any better method of introducing this article than by a sort of canvassing tour amongst the business men and men

of leisure. To canvass from house to house would hardly do. Either that method or the establishing of an agency here with refrigerators on hand all the time, making a strong effort to work up the trade to create a demand.

I think our American refrigerators, just as they are manufactured, are adapted for this climate. The only thing is to show the people the advantage of such an article in preserving goods and liquids, and that ice, though expensive, is not injurious if taken with moderation, and that a refrigerator may be both "a thing of beauty and a joy forever," especially in a hot climate.

Should any manufacturers desire to correspond with any firm here on the subject of taking the agency, offering terms, inquiring for terms, etc., I would recommend the firm of Corta Santos & Co. But the correspondence should be in Portuguese.

DAVID N. BURKE,
Consul.

UNITED STATES CONSULATE,
Bahia, March 15, 1890.

PERNAMBUCO.

REPORT BY CONSUL BORSTEL..

No refrigerators are used in this consular district, except a few hotels that are provided in that way.

The few in use at the hotels are manufactured in the United States at Burlington, Vt.

The Baldwin refrigerators, size 2 by 1.8 and 3 feet high, price $20. The Macey Diamond refrigerator, size 2.6 by 1.8 and 3 feet high, price $22.50. An ice-chest for cooling beer or wine, showing no marked name, price $16.50.

All ice here is artificially made by machinery; price per 100 pounds, $2.50.

Meats and fish can not be preserved more than one day in this hot climate, hence the little use made of refrigerators.

I have not the least doubt that the American refrigerators could be introduced here by an energetic man who would canvass from house to house for the sale of same, but he must speak Portuguese, and not become soon disheartened if he does not meet with success at first; it is almost impossible to get the people here interested in anything even if it is to their benefit.

It would be impossible for one to make any suggestions in regard to modifying the American refrigerators to meet local requirement, because, not being in the business, I have never given the subject any attention.

H. CHRISTIAN BORSTEL.

UNITED STATES CONSULATE,
Pernambuco, January 30, 1890.

BRITISH GUIANA.

REPORT BY CONSUL WALTHALL, OF DEMERARA.

Refrigerators are in general use in this colony, though to what extent I am unable to ascertain with accuracy.

No peculiar features are believed to be required in their construction.

So far as ascertained they are exclusively of American manufacture, and I am informed that the "Eureka" refrigerator and the "Diamond" ice-box are the kinds of which most have been sold. The sizes and prices vary.

The ice trade is at present in the hands of a firm (Messrs. Birch & Co.) who have a contract with the Government, by which they are required to furnish it, whether in larger or smaller quantities, at a uniform price of 1 cent per pound. On the other hand, the Government accords them the exclusive privilege of supplying the Government offices, hospitals, and other public institutions. They are bound to keep on hand at all seasons a sufficient supply for these purposes, and in case of failure are liable to a fine for every day of the deficiency. As regards the supply for private individuals and families, the business is open to competition, but although supposed to be in contemplation, no such competition has as yet been set on foot.

W. T. WALTHALL,
Consul.

UNITED STATES CONSULATE,
Demerara, February 20, 1890.

CHILI.

IQUIQUE.

REPORT BY CONSUL MERRIAM.

Refrigerators are used in this consular district to a very limited extent, their use being confined to the hotels and a very small number of well-to-do families.

No peculiar features are observed in the refrigerators here used, nearly all of which are imported from England and Germany.

The sizes vary from 2 to 3 feet in height, of about the same length and width, and are sold for from $20 to $40 American gold, or its equivalent in Chilian currency.

The ice consumed in this city is all manufactured by a German, who has no opposition or competition in the business, and who sells it in rectangular cakes at the rate of $10 (Chilian currency) per quintal of 100 pounds, or say $5 American gold, although, in fact, the quintal of ice never weighs more than 80 pounds.

Were there competition in the manufacture of ice and a consequent reduction of, say, 50 per cent. in the price, its consumption would, doubtless, be much increased, and there would be a corresponding increase in the use of refrigerators.

This is not a promising field for the introduction of refrigerators under the present conditions of ice manufacture.

J. W. MERRIAM,
Consul.

UNITED STATES CONSULATE,
Iquique, February 28, 1890.

TALCAHUANO.

REPORT BY CONSUL VAN INGEN.

All the ice used in this part of the country is brought down from the Andes, which are close by, in carts to the nearest railway station and thence transshipped to destination; but the quantity is very insignificant and is only for household use. There are no refrigerators used here.

All the preserved food and liquids used here are imported.

JOHN F. VAN INGEN,
Consul.

UNITED STATES CONSULATE,
Talcahuano, March 27, 1890.

DUTCH GUIANA.

REPORT BY CONSUL BROWNE, OF PARAMARIBO.

The articles that come nearest to refrigerators, in use in this colony, are ice-chests, which are imported here from Boston, and by Mr. A. N. Bixby.

There is no particular feature that I know of required in the construction of refrigerators for this district.

The ice-chests in use in this district are manufactured in the United States and in Holland.

The size of the ice-chests in use here is as follows: Length, 2½ feet; width, 20 inches; height, 2 feet; thickness of box, 3 inches.

Ice is imported in this colony from Boston by Mr. A. N. Bixby, shipping merchant, and is put up in an ice-house built according to the principle of those in use in the United States.

The price per 100 pounds of ice is $3. Price of the ice-chests, $10.

I would state, for the information of the manufacturers of refrigerators in the United States, that in this district we have only one city, and that is Paramaribo, which place has a population of 27,000, and of that number, to the best of my opinion, there are not more than from 400 to 500 people who use ice.

Nine-tenths of the population are poor and can not afford to purchase a refrigerator.

In regard to the preservation of food, the people here only buy enough to last from day to day, so that there is no danger of it spoiling in that length of time.

I think the best means for the manufacturers in the United States to introduce their refrigerators in this colony (that is, if they should think well of doing so, after reading this report) would be to send an agent down here with samples of the different kinds of refrigerators, and probably he might be able to dispose of some.

THOMAS BROWNE,
Consul.

UNITED STATES CONSULATE,
Paramaribo, January 22, 1890.

ECUADOR.

REPORT BY CONSUL-GENERAL SORSBY, OF GUAYAQUIL.

The total number of refrigerators in use in this district is about fifty, all of which are in use by private families. There are two large ones in use—one by the Lager Beer Association and the other by a saloon.

There are no special features required.

Those in use are of American patent and make. The sizes are 4 by $2\frac{1}{2}$ by $2\frac{1}{2}$ feet. Price here, $35 gold, two and three compartments, Jewett's Queen.

The Lager Beer Association manufactures the ice with an American machine, the La Vergen. The price of the ice is, wholesale, $2 gold per 100 pounds and 7 cents gold retail.

Food and liquids are not preserved, everything of that nature, when used at all, being imported. R. B. Jones & Co. would be the best parties to whom circulars, etc., should be sent.

WILLIAM B. SORSBY,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Guayaquil, January 20, 1890.

COLOMBIA.

BARRANQUILLA.

REPORT BY VICE-CONSUL WHELPLEY.

The Colombian housekeeper has a prejudice against keeping fresh meat uncooked; it must be cooked the day of killing; fish or fowl the same—a natural and necessary usage in a climate where the mercury stands at 84° to 86°, and the air teems with insect life to such an extent that two hours' exposure is often sufficient for the deposit of larvæ.

Given such atmospheric conditions, and the natural effect on animal food, when ice was an unattainable luxury, as it was a few years ago, and we must consider such a prejudice on the part of the housekeeper as reasonable.

Cooked food of any description left over from the meals of the family is considered the rightful perquisite of the servant, who may have several persons dependent upon her and with whom she shares the gleanings from the master's table. Consequently no cooked food is kept over from one meal to another; no perishable viands are preserved from one day to the next. This custom, hereditary from the days of Spanish rule, and the patriarchal simplicity of the early settlers with their large retinues of household slaves and poor dependents, is another reason why refrigerators are not considered a necessity.

The kitchens are generally in detached buildings or isolated inclosures, apart from the residences. The swarms of ants and other predatory insects, attracted by the odor of food, renders it necessary, and is another reason why its immediate consumption is preferable to its temporary preservation.

From my own household experience I believe that in a country so infested with insect pests the feet of any closet, safe, or refrigerator should be set in metal cups, the cups to be filled with water when necessary, or salt and kerosene, to prevent the entrance of vermin.

There are but two refrigerators, I believe, in actual use, and these were made in New York. But as the supply of artificial ice has heretofore been very uncertain, owing to defects in machinery or mismanagement, these can hardly be said to be in use.

The largest portable refrigerator, 5 feet by 5 feet by 5 feet (from Boston), was intended for a depository in an ice-cream establishment—a failure.

Steam-boats have their ice-boxes built in store-room or pantry.

The large earthen water jars, "Tinajas," keep the water sufficiently cool for drinking, generally 10° or 12° below the temperature of the air, and in the minds of many ice is a luxury of doubtful merit in a sanitary point of view. The limited consumption, from 500 to 700 pounds daily, may be increased hereafter, as there is a new apparatus being put up at the present time, promising a better quality and at cheaper rates. Ice is now from 5 to 7½ cents a pound. So far the drinking saloons, club-rooms, hotels, and steam-boats are the consumers, and as yet it is but rarely used in families. Economy in household expenses also has due weight among a people more accustomed to plain but substantial fare rather than luxurious living.

The duty on a refrigerator would be 20 cents a kilogram, with 25 per cent. additional. As to the best manner of introduction, perhaps circulars sent to the consulate for distribution would be the best preliminary step, if accompanied by illustrations and price-lists in Spanish. The

progress of new ideas, in conflict with hereditary domestic customs, must necessarily be slow, but the ultimate victory will be on the side of the greatest economy.

S. M. WHELPLEY,
Vice-Consul.

UNITED STATES CONSULATE,
Barranquilla, January 24, 1890.

COLON.

REPORT BY CONSUL VIFQUAIN.

Refrigerators are not in use in this consular district.

For this district they should be so constructed as to be saving of the ice.

I have found three refrigerators. One at the Pacific Mail Office, the Allegretti patent; it is used to keep cigars, hence not a success as refrigerator. I have found two at a store for sale, where they are liable to remain. They belong to the Jewett Manufactory, and they are both different. One is called the Queen; it sells for $40 Colombian currency, or $25 gold. The other is the Labrador; it sells for $35 Colombian currency, or $22 gold. There is no demand for them because they require too much ice. These refrigerators are manufactured in New York.

Ice is imported from the United States; principally from the Kennebec River. The ice traffic is in the hands of a monopoly; this monopoly is, by its contract with the Government, obliged to sell ice at 5 cents per pound.

This is in answer to the questions, and I submit the following for the information of the manufacturers of refrigerators.

If there is any country in the world where refrigerators are needed, this must be the country. But such a refrigerator is needed as will have a due regard for the saving of the ice, as this article is very dear.

The means resorted to here to preserve foods and liquids are ice-boxes of the "Ideal" model, manufactured in New York, from No. 2 upwards; they sell for from $10 to $20, Colombian currency, or from $6.50 to $13, American gold. They are a very unhandy affair, but answer the purpose better than refrigerators, simply because the latter use too much ice. A medium-sized refrigerator, saving of the ice, would be of great service to the people here, and would prove of good sale, provided the qualities of the same had been fairly tested. The best method for the manufacturers of good refrigerators to introduce them here is to send an active agent, with the knowledge of the Spanish language, on the spot; if this be considered too expensive, let them select a good house here.

VICTOR VIFQUAIN,
Consul.

UNITED STATES CONSULATE,
Colon, January 8, 1890.

PANAMA.

REPORT BY CONSUL-GENERAL ADAMSON.

Refrigerators are used in this consular district to a very limited extent. Dealers decline stating the number sold in a year, but I believe one dozen would more than supply the annual demand of this market.

There are no peculiar features required in the construction of those for this district. Those in use in this district are manufactured in the United States, probably New York.

The only ones I have seen are marked "Mace's diamond refrigerator." They are of four sizes, averaging about 3 feet in height, 30 inches wide, and 18 inches deep, containing in the upper half a zinc ice-box of about 24 by 15 by 15 inches, underneath which is the place for the food to be preserved; average price, $14 gold.

All the ice used here is brought from the State of Maine. The business is a monopoly. The Government stipulates with the monopolists that ice must be sold at not more than 5 cents, Colombian coin, per pound.

It is not customary in any of the countries of Spanish America to take the pains to preserve food such as is taken by our American housekeepers.

The people seem to provide only for their immediate wants, and ice is so expensive that there would not be much economy in saving food by the use of ice and refrigerators.

I do not know of any way by which the demand for refrigerators in this district can be increased to any great extent as long as the sale of ce continues to be a monopoly.

THOMAS ADAMSON,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Panama, January 27, 1890.

VENEZUELA.

REPORT BY CONSUL BIRD, OF LA GUAYRA.

Refrigerators are used to a very limited extent in Venezuela.

There are no peculiar features required in their construction, except that they should be made of walnut, to withstand the ravages of the wood maggot, so destructive to ordinary American woods.

Those in use here are imported from the United States.

The usual sizes and forms made in the United States are found to be suitable here. The prices are more than 100 per cent. greater than in the United States, owing to the fact that, duties being assessed on the gross weight, refrigerators pay heavy duty. For instance, one weighing 300 pounds, made of walnut, would pay $33.29 duty and $4.16 transit

tax. If made of ordinary wood it would pay $19.98 duty and $2.50 *transit tax.* By ordinary wood is meant maple, pine, oak, etc.

Ice is manufactured in Caracas, and is sold at $4 per 100 pounds. None is imported. It is believed that if a proper ice depot were established in La Guayra and importations of natural ice introduced from the United States a profitable trade might be eventually built up. By the tariff it is admitted free of duty. While ice is so dear here, the use of refrigerators will be necessarily very limited.

WINFIELD S. BIRD,
Consul.

UNITED STATES CONSULATE,
LaGuayra, January 11, 1890.

BRITISH WEST INDIES.

BERMUDA.

REPORT BY CONSUL BECKWITH, OF HAMILTON.

Refrigerators are used here extensively in hotels, saloons, and private houses.

There are no peculiar features required in their construction.

All used here are manufactured in the United States.

Those used here are of the same formations, sizes, and prices as those used in the States.

Ice is imported here from Maine in American vessels. Price per 100 pounds, 75 cents.

HENRY W. BECKWITH,
Consul.

UNITED STATES CONSULATE,
Hamilton, January 1, 1890.

JAMAICA.

REPORT BY CONSUL ALLEN, OF KINGSTON.

Refrigerators are in general use in this consular district and throughout the island of Jamaica.

They are of ordinary construction, such as are in general use in the United States.

Those in use in this district are manufactured in the United States.

Sizes 4 by 2 by 3 feet and upwards, as in the United States.

The price of ice is 75 cents for 100 pounds. All ice consumed in this district is manufactured by one company from machines of American pattern, and the management of the factory is under the direction of an American expert.

The steamers plying between tbe United States and outports of this island bring small quantities of ice occasionally, but the quantity being thus brought is limited and in no way affects the price of the article, thus this entire consular district is virtually dependent on Kingston for its supply.

W. G. ALLEN,
Consul.

UNITED STATES CONSULATE,
Kingston, February 3, 1890.

LEEWARD ISLANDS.

REPORT BY CONSUL JACKSON, OF ANTIGUA.

Little trade can be expected in this quarter owing to the hand-to-mouth method of living, the high price of ice, and the general poverty that prevails among the bulk of the population. Although Maine ice is in good supply, and we a population of 35,000, generally very thirsty, the consumption of ice rarely exceeds 300 pounds a day.

The retail price is $2 per hundred, but if it were furnished at half the price I doubt if the consumption would show much improvement.

A few refrigerators of American make were imported by the party having the ice contract here, and have been sold cheap to encourage the use of ice. They give good satisfaction.

In the Dominica consular agency district ice is kept in supply and retailed at 3 cents per pound; but the circumstances surrounding that place are much more aggravated than obtain in Antigua, consequently a very limited demand must exist for refrigerators.

The consular agency districts of Anguilla, Montserrat, Nevis, and Portsmouth are without ice, and a few pounds only would be consumed however cheap it could be supplied.

CHESTER E. JACKSON,
Consul.

UNITED STATES CONSULATE,
Antigua, February 28, 1890.

NASSAU.

REPORT BY CONSUL M'LAIN.

There are very few refrigerators in use in this colony, there being no supply of ice outside of this city and the high price of the article forbidding its general use in Nassau. I do not suppose there are fifty refrigerators, including all kinds, good, bad, and indifferent, in use in the entire Bahamas. They are never kept in stock by the merchants, and dealers inform me that the demand for them is so small as not to be worth mentioning. Now and then some person needs one and the merchant orders it for him.

Any ordinary refrigerator will meet all the requirements of the people of this colony.

The few in use are of American manufacture.

They are small ones, such as retail at from $8 to $12 in the United States, and are of all conceivable forms and patterns. A few, known as the "Eddy" and the "Arctic," have been imported within a year or two.

The supply of ice comes from Maine, imported in schooners. No attempt has ever been made to manufacture ice here, those interested

having figured out that it would not pay to do so. The use of ice is confined to comparatively few families, and probably the quantity sold per annum will not exceed 400 to 500 tons. The price varies, ranging from 2 cents to 4 cents per pound. A large ice-house is owned by the Government, which is rented to parties who give bonds to keep a supply of ice always on hand, to be sold at not to exceed 4 cents per pound. The hotel here has its own ice-house and imports 200 tons per annum.

Families who desire to preserve meats or poultry for a few days send it to the "ice-house," where it is kept for a small consideration. Beef, mutton, etc., are used the same day as killed as a rule; poultry killed when needed; fish sold alive every day in the market.

I do not see any way of introducing refrigerators into this colony at present more extensively than they are coming in at this time. It is only now and then that one is needed, and it is at once ordered by some merchant from New York.

Ice is too dear, the people are too poor, the need of refrigerators is not felt enough to warrant any expectations that a trade worth having can be developed in this article in the Bahamas. The only consolation is that whenever any are purchased they are bought in the United States.

THOS. J. MCLAIN, JR,
Consul.

UNITED STATES CONSULATE,
Nassau, N. P., January 8, 1890.

TOBAGO.

REPORT BY CONSULAR AGENT KEENS.

Refrigerators are not at all used on this island.

Ice is seldom imported, occasionally a few hundred pounds are procured from Trinidad or Barbadoes for special occasions, when its cost is very high, but it is not generally used by the inhabitants.

I have no doubt that if this article could be procured at a low rate and in small quantities to meet the consumption of the island greater advantage would be taken of it, and refrigerators or machines for making ice on a small scale might be the means of establishing its use.

I think that it would be well if I were furnished with catalogues and price-lists of several makes so as to see what could be done in establishing such a system.

EDWARD KEENS,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Tobago, February 14, 1890

TRINIDAD.

REPORT OF CONSUL SAWYER.

Refrigerators are in use in this district and to a large extent.

There are no peculiar features required in their construction other than the usual ones manufactured in the United States—chest and upright ones.

Those in use are manufactured in the United States, chiefly in Boston.

The sizes are various; small, medium, and large, chest and upright principally. Prices vary from $6 to $24 each.

Ice is imported into this island from the United States, principally from Boston. The price is generally $1 per 100 pounds excepting in times of scarcity.

MOSES H. SAWYER,
Consul.

UNITED STATES CONSULATE,
Trinidad, January 29, 1890.

FRENCH WEST INDIES.

GUADELOUPE.

REPORT BY CONSUL BARTLETT.

Refrigerators are not used in this consular district. I know of but one in Guadeloupe, and that I have myself at my little country place, and it is of the old style I purchased about fifteen years ago.

There being none used, this replies to interrogatories 2, 3, and 4.

There are two ice establishments, situated at Pointe-à-Pitre; one a French company, manufacturing artificial ice sold at their establishment, which manufactures only the quantity required daily; the other, part owned here and a portion in the United States, is called the "American Ice Company," which imports ice from Maine, which is secured in an ice-house built on the same principle as those in the State of Maine.

There is also an ice retailing establishment at Basse-Terre, to which the Government grants a subsidy of 2,000 francs per annum. There is a similar one at the Moule, which receives an annual subsidy of 1,200 francs from the town; another one, established at St. François, receives 600 francs subsidy per annum. There was one at Capesterre receiving an annual subsidy of 1,500 francs, but this subsidy having been withdrawn in January this year the establishment was subsequently closed.

The ice establishments at Pointe-à-Pitre do not receive any subsidy.

Ice purchased in town for the country is generally wrapped up in coarse woolen blankets.

The retail price of natural ice at Pointe-à-Pitre, for the present, is 25 centimes per kilogram, and at wholesale 150 francs per ton of 1,000 kilograms.

Artificial ice is retailed for 20 centimes (4.8 cents) a kilogram (2.205 pounds), and at wholesale 120 francs per ton of 1,000 kilograms.

Both natural and artificial ice are sold at retail in Basse-Terre for 30 centimes (5.8 cents) a kilogram.

At the Moule, St. François, and Capesterre it is retailed at 40 centimes a kilogram.

There is no ice sent round in carts, as customary with us. The families purchase their food in the morning sufficient for the daily supply. Bread is obtained fresh every day from the bakeries.

The butchers slaughter just sufficient for their daily sales, and should any quantity of beef happen to be left on hand, it is sent to the ice-house to be put in the ice-chest.

It seems to me that refrigerators ought to be used; and if the manufacturers of refrigerators were to address catalogues of their different

kinds of refrigerators to the ice companies here, I have no doubt but that some of the families in Guadeloupe might be prevailed upon to make use of them.

CHARLES BARTLETT,
Consul.

UNITED STATES CONSULATE,
Guadeloupe, February 18, 1890.

MARTINIQUE.

REPORT BY CONSUL GARESCHÉ.

Refrigerators are used in this island to a very limited extent, principally by hoteis and a few large boarding-houses.

Save one imported last year from Burlington, Vt., I know of none that are not of the primitive manufacture of this island.

From the above observations it can be inferred that not only are the refrigerators here used manufactured in this island, but that it would be impossible to give even an adequate idea of the sizes, formations, and prices thereof in this district.

Ice is almost entirely the product of machinery here, save, perhaps, an occasional cargo sent to Fort de France from the United States mainly for the use of the steamers of the Compagnie Generale Transatlan tique.

Without distinction between the natural and artificial product, ice retails here the year round at 3 cents per pound, very little, if any, deduction being made for purchases in large quantities.

In conclusion I would say that refrigerators of moderate size might be profitably introduced here. At all events, since the modern article is almost entirely unknown, the venture might be worth the risk.

In my estimation, the best manner of introducing refrigerators would be to send a sample to each of the leading clubs here—there are two—and one to the leading hotel in Fort-de-France, and also to the only hotel in this city of St. Pierre. In this way their benefits could be appreciated, and the enterprising manufacturer who is willing to risk this much would profit by the education of this people.

Perhaps this would be ultimately cheaper than sending a commercial traveler here.

If any manufacturer desires to send one first-class specimen, of moderate price, I will gladly take charge of it and place it in such public location as may best serve to advertise the article.

WM. A. GARESCHÉ,
Consul.

UNITED STATES CONSULATE,
Martinique, March 12, 1890.

HAYTI.

REPORT BY MINISTER DOUGLAS, OF PORT AU PRINCE.

The refrigerators are not at all in general use here; they are, in fact, very rarely found either in families or in places of popular resort. The people here have never been accustomed to them, and do not feel the need or in general know the value or use of them.

Ice is brought here in vessels from the United States, usually from Maine. The price of it is $5 per 100 pounds. The articles exported from this country to the United States are of such a nature as to appear not to require samples of them to be transmitted to the collectors of customs of the ports of their destination, as contemplated in the circular of November 27, 1889.

FREDERICK DOUGLAS,
Minister.

UNITED STATES LEGATION,
Port au Prince, January 16, 1890.

SAN DOMINGO.

PUERTO PLATA.

In answer to refrigerator circular of November 25, 1889, I have to report that no refrigerators are used in this district, nor is ice obtainable for any purpose.

THOMAS SIMPSON.

UNITED STATES CONSULATE,
Puerto Plata, February 27, 1890.

SPANISH WEST INDIES.

CUBA.

HAVANA.

REPORT BY CONSUL-GENERAL WILLIAMS.

With the view of obtaining reliable information upon the subject, I addressed a note on the 26th of last month to Mr. F. K. Sowers, a citizen of the United States established here, he being thoroughly informed both with respect to the importation of refrigerators and the manufacture of ice in this city. Accordingly, I inclose for the information of the Department a copy of the answer of Mr. Sowers, dated the 27th of December ultimo.

RAMON O. WILLIAMS,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Havana, January 13, 1890.

Mr. Sowers to Consul-General Williams.

In reply to your esteemed favor of yesterday with copy of circular from the Department of State asking for information regarding the use of refrigerators and how ice is obtained in this city, I take pleasure in answering the five questions therein contained, to the best of my ability, thus:

Refrigerators are used in this city, but to no great extent.

There are no peculiar features required in their construction for use in this place; still I will say that some people prefer those prepared with separate compartments for water, as many like cold water, but do not want ice put in it.

Most of the refrigerators used are imported from the United States, some few from France, and still a smaller number made here.

Different sizes are used, say for families, 24 inches front by 36 inches height up to 40 inches front by 50 inches height, up to 75 inches front by 65 inches height; the class known as "upright" are generally preferred to the "chest." Prices from $20 to $150, according to size, class, material used, and fancy work.

Ice is manufactured here, and price at present from 60 to 80 cents per 100 pounds, according to quantity and location of delivery.

I would also add that I am inclined to think the use of refrigerators would become more general if they could be delivered here cheaper. The high freight and duties increase the cost beyond the means of many people. Possibly it might be an object to large manufacturers in our country to ship them in the "shook" form and then erect or put them together here; but in this case it would be necessary to send down an experienced man to do the work.

F. K. SOWERS.

Havana, December 27, 1889.

MATANZAS.

REPORT BY CONSUL PIERCE.

Refrigerators are used in my consular district to the extent of about fifty per year.

There are no peculiar features in their construction and all are manufactured in the United States. The prices vary from $10 to $70, according to sizes and formations, which also differ to suit the wants of the purchasers. The ice used in this consular district is supplied from Havana, and the price is $6, Spanish gold, per 100 pounds.

The best manner of introducing refrigerators is through commission houses.

FRANK H. PIERCE,
Consul.

UNITED STATES CONSULATE,
Matanzas, January 14, 1890.

SAGUA LA GRANDE.

REPORT BY COMMERCIAL AGENT MULLEN.

Refrigerators are almost unknown in this district, there beiug but one in use here.

The ordinary American refrigerator would fill all the requirements necessary.

Ice is secured in home-made chests consisting of two ordinary boxes, the inner one lined with zinc and the intermediate space between both boxes packed with ordinary salt. There are two deposits of this kind in this district, each one capable of storing about five tons of ice. This ice, which is artificial, is purchased at $16 per ton and sold here at $3 per hundred-weight.

At a first glance it would seem that a refrigerator of some kind would be an absolute necessity in this climate; but when it is understood that the meat intended for daily use is slaughtered every day, it will be apparent that the necessity is not so urgent. Meat killed at 2 p. m. is in some instances placed on the table for use at 6 p. m., and, as a general rule, is tough and unpalatable. During the warm summer months meat becomes tainted inside of twenty-four hours. At the hotels and restaurants meats are kept in an ordinary ice-chest and in direct contact with the ice. Have consulted various persons regarding their opinion, and the general verdict is that the refrigerators are too large and costly. I would therefore suggest for the use of this district a plain, medium-sized refrigerator, the cheapness of which will recommend it to the public in general. The best manner of introducing this and all other manufactures would be through an agent who thoroughly understands the business, and who has a good knowledge of the Spanish

language. The sending of agents to this country who do not understand the language is a failure, as all their business must be done through an interpreter who is not well informed on the subject and fails to convey the ideas of the agent. In cases where it is impossible to send a special agent, would recommend the appointing of a resident in the various towns and cities. Printed circulars in English is money thrown away.

D. M. MULLEN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Sagua la Grande, January 22, 1890.

SANTIAGO DE CUBA.

REPORT BY CONSUL REIMER.

The fact that on an average only 3 tons of ice per day are consumed in the city of Santiago de Cuba, boasting of a population of nearly 48,000 souls, is conclusive proof that the resources of the people do not permit a large consumption of ice. The exorbitant prices charged by the local company manufacturing artificial ice—$2.50 Spanish gold per 100 pounds wholesale, and $5 Spanish gold per 100 pounds retail—is no doubt, to a great extent, to blame for this, but not altogether. It seems that the colored element, which composes two-thirds of the population, consumes no ice at all, and this, in many instances, because they are not used to it, and I am convinced that even were ice cheaper they would not use it. Almost all the ice consumed here is used by Spaniards and foreigners. The twenty-two to thirty head of cattle killed daily to supply meat to the city are consumed the day following, and are brought from the slaughter-houses direct to the market. Poultry is all sold alive, and killed just before preparing for the table.

The only refrigerator in use here is an old one of American manufacture at the restaurant "La Venus," the largest restaurant here. At the high prices of ice private families use no ice-boxes, but buy their supply to cool beverages daily before meals, and in pieces of 1 to 5 pounds.

It is my opinion that before refrigerators can be introduced here the price of ice must be reduced. I have been requested by people whom I have interviewed in reference to the circular to procure for them circulars of large ice-machines and small ones for family use. As soon as competition can put the price of ice on a basis so that the public can be large consumers, I believe there is a field for the sale of refrigerators of American manufacture.

OTTO E. REIMER,
Consul.

SANTIAGO DE CUBA, *January* 10, 1890.

CONTINENT OF ASIA.

BRITISH ASIA.

BOMBAY.

REPORT BY VICE-CONSUL BODE.

Refrigerators have very little demand in my consular district. It is very difficult to sell, say, thirty or thirty-five of them in a year. They are only used in some hotels and clubs and not in every family, because they have not adopted the system of preserving food and liquids. When people want to preserve ice in summer they have large wooden boxes lined with zinc or tin-plate, which only cost them 10 rupees (1 rupee equals 32.2 cents), while the English-made refrigerators are sold from 50 to 100 rupees.

There are factories established in Bombay since 1872 and up-country for the manufacture of ice, which is remarkably cheap. Price for 100 pounds is only 3 rupees, equivalent to $1.

H. E. BODE,
Vice-Consul.

UNITED STATES CONSULATE,
Bombay, February 28, 1890.

CALCUTTA.

REPORT BY CONSUL-GENERAL BONHAM.

Refrigerators are quite extensively used in this consular district by hotel and boarding-house keepers, as well as by many private families.

The only peculiarity or requisite in the construction of refrigerators for use in this climate is, that they should be made of lumber that is the least susceptible to shrinkage during the dry season and to expansion or swelling during the rains, and which is not subject to ravages by the white ant. The form of construction is substantially the same as of those in common use in the United States. In fact, I was told by a member of a large and reliable firm in Calcutta (Messrs. T. E. Thompson & Co.), who, amongst other things, manufacture refrigerators for the Calcutta and surrounding markets, that some years ago they procured some refrigerators from the United States which were satisfactory in the form of construction but which were defective in the quality of the lumber on account of its susceptibility to shrink and swell. During the dry hot weather (my informant stated) the joints

would open so as to let in the hot air, and during the wet weather the wood expanded so that the doors could not readily be opened or shut. Said firm then ordered another consignment of refrigerators from the United States made of hard wood, and these worked better, but were not entirely satisfactory in the respects above named.

Messrs. Thompson & Co. then turned their attention to the manufacture of refrigerators from Indian teak-wood, which is used very extensively in this country in the manufacture of furniture and for various other purposes, and is said to be less liable to shrink and swell than any other wood that is generally obtainable in this country. It should also be understood that the white ant of India, which bores into honeycombs, and destroys most kinds of soft woods, very seldom disturbs teak-wood.

The refrigerators in use in this district are manufactured in this country. The labor of a native carpenter (without board or lodging) is from 12 to 15 rupees per month ($4 to $5), and that of a good native cabinet workman about double that of the carpenter. Of course the native mechanic works by hand and his tools and other mechanical appliances are of very simple construction. But, considering the great disparity in the price of mechanical labor between this country and the United States and the superiority of the Indian teak-wood for climatic and other reasons stated, I am afraid that the outlook for building up a trade in refrigerators in this country is not very encouraging. I also find that the few American carriages which have been brought to Calcutta do not stand the climate here so well as those manufactured in the country of teak and other hard Indian woods.

From Messrs. T. E. Thompson & Co. (above referred to), I learn that the common sizes manufactured by them are as follows: 36 by 26 by 21 inches on stand and 30 by 22 by 19 inches on stand. They retail the larger size at 110 rupees (about $36.33) and the smaller at 100 rupees (about $33.33).

The refrigerator above referred to has a zinc ice-box in the top, with with a small lead pipe leading from it to the lower part of the main box, which is also provided with a zinc basin in which wines, etc., may be placed for cooling, and upon which the ice-water trickles through the small pipe referred to. The intervening space between the ice-box and wine-basin is provided with the ordinary gridiron shelves (usually one or two) as receptacles of such articles of the cuisine as it is desired to keep cool.

All the ice we have here (nearer than Kunchinginga) is manufactured and sells at about $1 per 100 pounds.

Prior to the discovery of the art of manufacturing ice, I believe the principal supply of that luxury was shipped here from the United States.

B. F. BONHAM,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Calcutta, February 4, 1890.

STRAITS SETTLEMENTS.

REPORT BY VICE-CONSUL LYALL, OF SINGAPORE.

Refrigerators are not used in this country to any great extent. Most private residences of the better class have an ice-box of some kind, but ice is cheap and generally is kept by the servants in a gunny bag, blanket, or wooden box with saw-dust, washed at meal-times and put into the drinking-glass. Meat in this country must be cooked within twenty-four hours, all the year round, after being killed, so that refrigerators on a large scale, if kept by butchers, would be most useful and one would suppose very profitable, but there is nothing of the kind here.

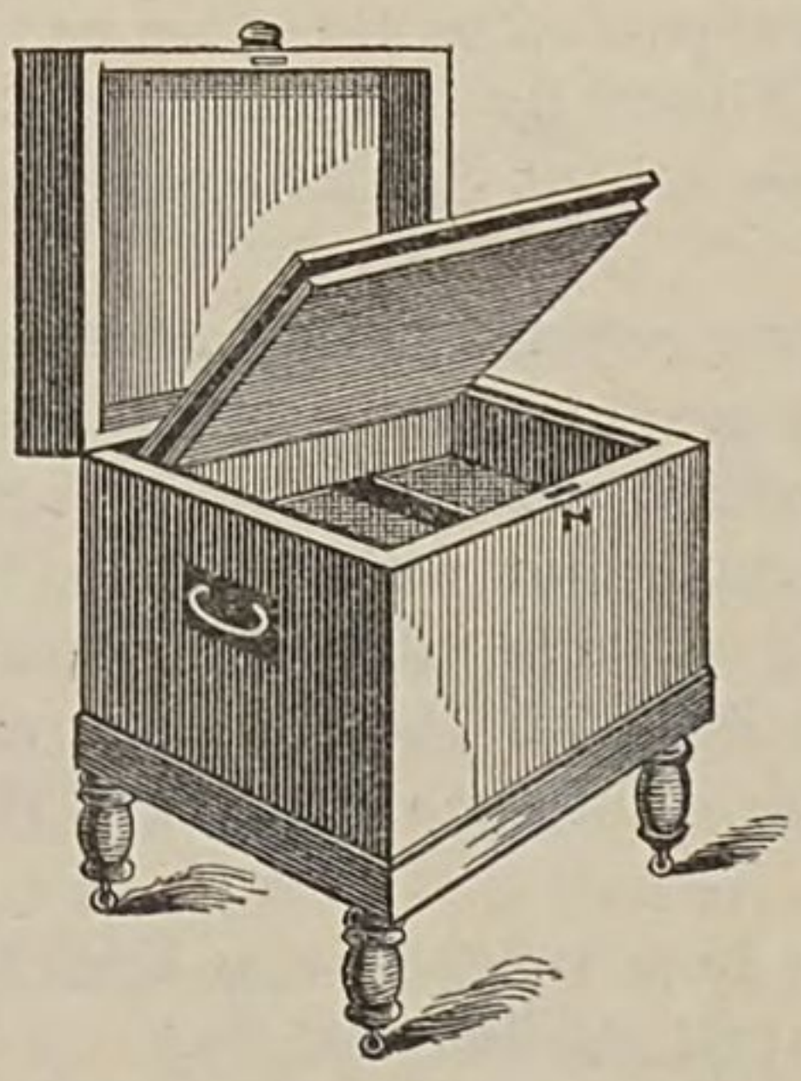
The sketch attached to query No. 4 gives an idea of the refrigerators used here.

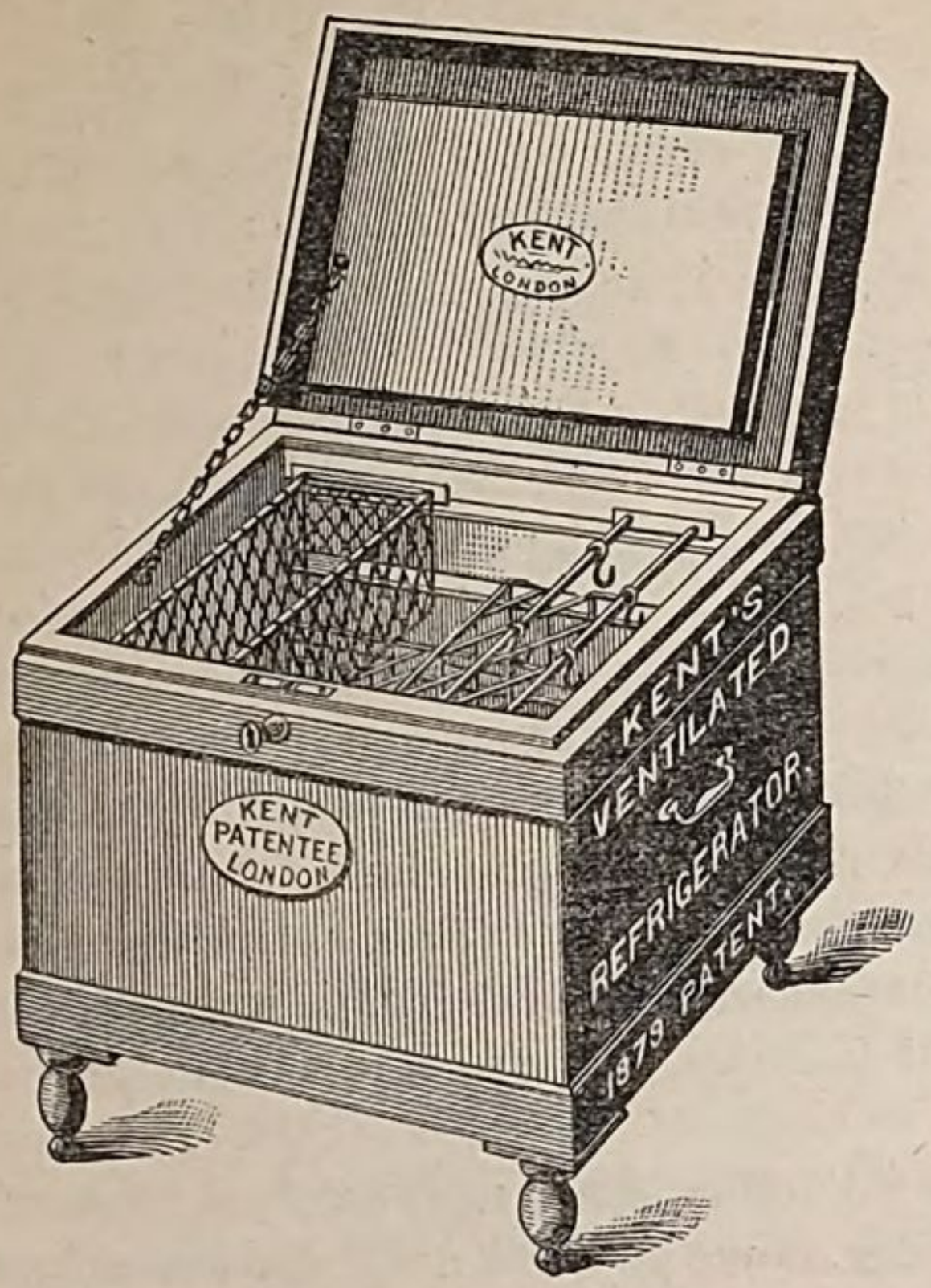
The refrigerators in use in this district come chiefly from England and Germany, occasionally from the United States, and are also made on the spot.

A German mercantile firm, who say they receive consignments of refrigerators from Germany in invoices of half a dozen at a time, give the following prices (wholesale), viz: 30 by 24 by 24 inches, $20 each; 42 by 24 by 24 inches, $30 each.

A retail shopkeeper (the principal shop in the place) reports as follows: 25 inches square, $15; 28 inches square, $18; 31 inches square, $24. Kent's refrigerator, 22 by 20 inches, $40.

The sketches attached hereto show the Kent boxes.





Ice is made daily to meet the current demand, and is taken from the manufactory, as required, by the servants of consumers. The retail price is one cent per pound. For large quantities some abatement would be made.

An efficient and well kept refrigerator every one acknowledges in tropical countries to be a great boon, and if asked why in that case they are not more in use in this district, I think the reason is mainly that the native servants do not properly understand them or will not take the trouble to handle them; and perhaps also it may be due in some degree to the inefficiency of the refrigerators in use.

A refrigerator which will keep its contents really cool with little trouble should become popular in this place.

The best mode of introducing American refrigerators into this district would be the usual one of a trial consignment, with full information as to the mode of handling them. It must be kept in mind that the European community, who are the only users of refrigerators, is comparatively small, and a trial consignment of half a dozen boxes would be ample.

J. LYALL,
Vice-Consul.

UNITED STATES CONSULATE,
Singapore, March 4, 1890.

CHINA.

CHINKIANG.

REPORT BY CONSUL JONES.

The refrigerators in use in this district are very few and are simple ice boxes or chests about 2½ feet square in area at the top and 3½ or 4 feet high. They have two compartments, the top one for the ice and the one below, divided by an open shelf, for meats, butter, etc. They are made of pine wood, lined with zinc, and filled in with charcoal, are of American manufacture, and cost from $12 to $15. They answer the purpose for small families, but are entirely inadequate for anything beyond this.

The winters in this climate are never very severe. The ice is secured from ponds of water, some of them made for the purpose, and is rarely over an inch in thickness. It is stored in ice houses constructed very like the old fashioned ice houses in the United States, by digging a chamber in the earth, lining the sides and floor with planking, and covering with a straw roof.

The water in the ponds can not be said to be of the purest, as it is used by all the families in the neighborhood, who wash their clothes in it, and is also the resort of all their ducks, geese, and buffalo. The ice, therefore, can never be used by mixing it with liquids. Bottles of water, etc., for table use, are kept cool by burying them in it.

The cost of ice in the summer is about 60 cents per picul (133⅓ pounds). The Chinese do not use it and seldom drink water. The common beverage is tea, which is drank hot and without milk or sugar. This tea is a weak infusion of the common leaf, the cheapest possible commodity, and is accessible to all.

As ice is expensive and often difficult to secure, moderately cheap and easily managed machines for the manufacture of ice would find a ready market in this country. At several of the ports of Japan ice-machines are in use, but they are, I believe, of English manufacture, and too expensive for small communities or family use.

The best method of introducing modern American refrigerators into this district would be for a manufacturer to send one as a sample, that the people may see and understand its use.

A. C. JONES,
Consul.

UNITED STATES CONSULATE,
Chinkiang, March 18, 1890.

HONG-KONG.

REPORT BY CONSUL SIMONS.

Refrigerators are in use in every house, with the exception of those occupied by Chinese, in all hotels, restaurants, clubs, stores, and on steam-ships. The temperature rarely falling below 60° Fahrenheit during the winter months and for the other eight months of the year rarely below 80° Fahrenheit, with the maximum of moisture in the atmosphere, which, quite as much as the long continued high temperature, facilitates decomposition and fermentation, refrigerators become a necessary appliance toward securing the ordinary comforts of life.

No peculiar features of construction are required in addition to securing the greatest cold with a given quantity of ice for the longest time, a purpose arrived at doubtless in the construction of refrigerators for use in any country.

With scarcely an exception, those in use are manufactured by Chinese cabinet-makers after the patterns of those brought to the colony by Europeans many years ago.

These people imitating everything, while practically originating nothing, makes it extremely likely that, should refrigerators of an improved American pattern be brought to this market in such numbers as to enter into competition with them, they would soon begin the manufacture of them at prices so low that competition would be impossible, the wages paid for such work not exceeding 30 cents a day. Sizes range from 3 feet, costing from $8 to $20 Mexican. Those used on board coasting steamers are much larger, costing in proportion. They are made in wardrobe shape, not unlike those in use in the United States; the outside of wood, 1 inch in thickness, lined with zinc or tin, with a box for the reception of ice at the top. None that I have seen are filled with non-conducting materials or substances.

Ice is manufactured by the usual ammonia and damp-air machines and sold at $1.50 per hundred pounds. I inclose the annual report of the ice company, which indicates a prosperous condition of their affairs.

As to the best manner of introducing refrigerators of American make, which are no doubt greatly superior to those now in use here, a difficulty presents itself already stated, the certainty of their being imitated by Chinese workmen; another, the absence of any tradesman engaged in in selling goods of American manufacture; so that there is no one to whom a consignment could be made with a reasonable hope that merit alone would be sufficient to create a demand. Considering the number of places on this coast where refrigerators are used it is likely the sending of an agent capable of setting forth the advantages of the thing he sells, after the manner of the commercial traveler, while at the outset attended with considerable expense, would, in the end, secure the most substantial results.

O. H. SIMONS,
Consul.

UNITED STATES CONSULATE,
Hong-Kong, February 11, 1899.

[Inclosure in Consul Simons's report.]

THE HONG-KONG ICE COMPANY, LIMITED.

The following is the ninth annual report:

The general managers beg to submit to the share-holders a statement of the company's accounts for the year 1889:

The business of the company has continued to improve, and the result of the year's operations, inclusive of balance from last account, is a profit of $37,896.78.

On the 2d August last an interim dividend of 7 per cent. was paid, which absorbed a sum of $8,750, and there is now a balance to be dealt with of $29,146.78. This will admit of the payment of a further dividend for the year of 17 per cent., or $4.25 per share (making 24 per cent. in all) $21,250.00, and an addition to reserve and depreciation fund of 7,500.00, leaving to be carried forward to new account 396.78; total 29,146.78.

In order to meet the increased demand upon the company it has been found necessary to substitute for the old dry-air machine, which is now obsolete, a modern one, and the order has been placed in the hands of Mr. Bain, the late manager. The cost of the new machine, together with the extension of the present buildings, it is estimated will amount to about $25,000.

The ammonia and damp-air machines were continuously at work day and night during the summer months.

The accounts have been audited by Mr. Thomas Arnold, and the general managers recommend that he should be re-elected auditor.

JARDINE, MATHESON & CO.,
General Managers.

HONG-KONG, *February* 3, 1890.

ASSETS.

Property account	$161,368.05
Invested in Hong-Kong Fire Insurance Company's share	345.00
Cash on hand	281.78
Hong-Kong and Shanghai Bank, current account	27,676.88
Hongkong and Shanghai Bank, deposit account	9,000.00
Outstanding accounts	1,715.83
Accounts receivable	393.29
Ice on hand	180.00
Stores on hand	84.00
Extension account	2,464.26
	203,509.09

SHANGHAI.

REPORT BY CONSUL-GENERAL LEONARD.

There are about eight hundred foreign houses in Shanghai, and it is doubtful if there is one wherein a refrigerator or ice-box is not in use seven or eight months of the year.

There are no peculiar features required in the construction of refrigerators for this district, except that the ice-chamber should be larger than usual, to hold the ice as frozen and gathered as described in No. 5.

The refrigerators in use in this district are manufactured here with the exception of a few imported from the United States.

The common-sized ice-box ranges to meet the wants of the family. Ice-chambers are on top or side, and the cool chamber adjoining. Price from $15 to $50.

Ice is gathered from rice fields flooded with dirty water pumped from stagnant ditches and ponds, the temperature at which it is frozen is seldom lower than four or five degrees below the freezing-point. It is stored in houses built on the level ground, having mud walls 10 or 12 feet high and covered with straw or tiled roofs. The ice frozen at such a high temperature melts very rapidly, so that refrigerators have ice-chambers larger than usual.

In addition to the natural ice, there is a small ice-machine, but its limited power and the cheapness at which the natural ice can be purchased from the native dealer leaves but little room for its business.

The average price of the natural ice is 50 cents per 100 pounds.

J. A. LEONARD,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Shanghai, February 24, 1890.

TIENTSIN.

REPORT BY CONSUL BOWMAN.

Refrigerators in this consular district have a very limited use among the American and European residents and among a few of the wealthier Chinese families.

No peculiar features are required in their construction as far as I know.

Those in use here are made by individual carpenters.

The kind used among the Chinese are simply tin-lined boxes, with holes below for draining off the water. There are no regular sizes or prices.

The kind used by the foreign residents are also manufactured on the spot by Chinese carpenters, and vary in size and price according to the caprice of the person ordering.

Ice is obtained from rivers and ponds, and is usually sold at about 25 cents per 100 pounds.

I regret that owing to the nature of the case my replies to the questions asked have been rather indefinite.

WILLIAM BOWMAN,
Consul.

UNITED STATES CONSULATE,
Tientsin, March 7, 1890.

JAPAN.

OSAKA AND HIOGO.

REPORT BY CONSUL SMITHERS.

Refrigerators are used in this district by foreigners, but not by the Japanese. The demand for them, therefore, is limited. The greater part of those in use are made in the country by the native mechanics and have no peculiar features in their construction. They are wooden boxes, made as far as possible air-tight and lined with zinc, with an open lattice-work partition, below which the ice is placed. These ice-boxes, as they are called, cost from $10 to $15.

Large quantities of ice are used by the Japanese as a beverage, but not to preserve meats or liquids. This ice comes from Hakodate and costs 1½ cents per pound. Large factories at Osaka and Hiogo are now manufacturing ice, which retails in small quantities at about the same price as the natural article.

E. J. SMITHERS,
Consul.

UNITED STATES CONSULATE,
Osaka and Hiogo, March 6, 1890.

NAGASAKI.

Refrigerators are only used in this district by private foreign families; and they have no features different from those in use in America, as to size, formation, or price.

Ice is secured in this district by importation from Tientsin, China, and within the last year a limited quantity has been manufactured by a Japanese company operating an ice-machine.

Price per 100 pounds, Tientsin ice, about $2.50; manufactured ice, $1.

JOHN M. BIRCH,
Consul.

UNITED STATES CONSULATE,
Nagasaki, June 18, 1890.

PHILIPPINE ISLANDS.

REPORT BY CONSUL WEBB, OF MANILA.

In a climate where the thermometer averages 90° the year round, an ice-box or cooling apparatus of some kind is considered a necessity by those who have the means to procure the comforts of life. Hence in Manila, Iloilo, and Cebu, the leading cities of the Philippine Archipelago, an ice-box may be found in the house of almost every foreign resident and in those of most of the well-to-do Mestizos. In Manila there are three ice-machines, one American (the De la Verne), one Swiss, and one German, which make about 18 tons of ice per day. Iloilo has one German machine and Cebu another. Families are supplied at 1 cent per pound and a single ton sells for $25;* special rates are made for larger quantities. The ice is produced in blocks weighing from 800 to 900 pounds and is then cut into oblong blocks weighing 10 and 25 pounds each for delivery to families. Twelve or fifteen carts are used for the purpose of delivery and there are as many more small depots in various parts of Manila where ice is retailed in quantities of 1 pound and upward. As a rule the ice is of excellent quality, being as clear as crystal, although occasionally a lot slightly clouded is turned out. Until about a year ago the product was usually like frozen snow and was always more or less clouded, but Señor Don E. M. Barretto, who has a monopoly of the ice business in Manila, has invented an improvement in the process of molding the blocks which clarifies them perfectly.

Owing to the prevailing system of supplying the family cook in the morning with the money necessary for each day's provisions there is little or no accumulation of food to be preserved from one day to another, and hence the ice is used principally for cooling drinks. The native method of preserving meats and fish is by drying or smoking them; the cooks buy these articles at the markets fresh every morning and, as the native rather prefers his meat a little tainted, the butchers usually get rid of all their stock in trade at a fair price. The native method of preserving meat and fish is to cut long gashes in it about an inch apart and hang it in the sun. Sometimes he salts it, and salt meats may be found in most of the markets.

The refrigerators are, as a rule, plain, double-walled, wooden boxes of various sizes, made by the Chinese cabinet-makers here and sold for from $10 to $18. The spaces between the walls are filled with sawdust, and the box inside is lined with zinc, with a half-inch hole in the bottom for an escape for the water. Midway between the top and bottom of the

*An evident error, but just as the consul wrote it. It should, perhaps, be a cent and a half per pound.

inner space and extending half way across it, is a zinc shelf, on which the ice rests, and the space around it is usually utilized for the storage of bottles of wine, beer, liquor, etc. The idea prevails generally that putting ice into the water is injurious to health, and the latter is therefore put into clean bottles, which are laid on the ice; but Señor Barretto tells me that since he has been producing clear ice there has been a largely increased amount of it put into beverages of all kinds. Should this practice become general, there would undoubtedly be a demand for the refrigerators with the zinc or iron water tanks in general use in the United States and the plain ice-boxes now in vogue would be discarded by those who could afford something better. But at present the latter fills all the requirements of domestic use and, as $15 and $18 are considered the highest prices that ought to be paid for such an article, when provisions and the other necessaries of life cost as much as they do here, it would, in my opinion, be difficult to find a profitable market here for the better class of American refrigerators.

The best manner of introducing American refrigerators would be to have an active, energetic salesman here who could speak the Spanish language. The next best method would be to induce one of the English, German, or Spanish houses to accept the agency for the manufacturers and make a special feature of American refrigerators. There are no American dealers here, and extra inducements would probably be necessary to stimulate interest in the making of sales. Indifference and even opposition would be met with at first, but perseverance and tact would undoubtedly secure satisfactory results.

The duty on refrigerators is 10 per cent. of the declared value, 20 per cent. on the duty for port tax, and $1 per ton.

ALEX. R. WEBB,
Consul.

UNITED STATES CONSULATE,
Manila, January 24, 1890.

SIAM.

REPORT BY CONSUL-GENERAL CHILD, OF BANGKOK.

Only a small number of refrigerators are used here.

There are no peculiar features required in their construction, except that they are almost exclusively used to cool bottled aerated waters and liquors.

They are of local Chinese make.

They are generally box-shaped, lined with zinc, and vary in price according to size and contract with the maker.

Artificial ice at $2.50 per 100 pounds.

JACOB T. CHILD,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Bangkok, February 26, 1890.

TURKEY IN ASIA.

ASIA MINOR.

REPORT BY CONSUL EMMETT, OF SMYRNA.

The use of refrigerators is so limited as to warrant me in saying as a household convenience they are unknown. Less than a dozen are in use in this city, and those are in beer saloons.

I should judge that a good cheap article would be the only one to find sale; and owing to the extreme carelessness of servants one fed from top with ice compartment separate from food closets would be most likely to find favor and do good service.

The refrigerators in use in this district are manufactured in Germany. The sizes are large, for holding beer kegs.

There are two factories for the manufacture of ice which run six months in the year and have very moderate success. A supply of snow is gathered in the mountains during severe winters and stored in large holes. This is covered over with some rock salt and pine leaves. During the summer this snow is brought to the city in thick felt bags and disposed of mainly to confectioners. The use of ice is by no means general and is considered very unhealthy in this climate. Since the artificial-ice factories have been established, the use of snow for refrigerating purposes has diminished. The price of either is about $1 per 100 pounds.

The practice of hanging meats, poultry, etc., to ripen is unknown here and meat is generally used within twenty-four hours after killing. As to poultry the time is much less, unless the same is to be consumed by Europeans.

I have great doubts as to the feasibility of introducing American refrigerators into this market with success. Such a thing is not to be found for sale nearer than Constantinople, and the demand there is very limited.

The only firm in Smyrna who deals in American inventions is Jacob Balladur & Co. If any trade can be established for refrigerators here, they can give definite information as to size, prices, and terms upon which the goods can be sold.

W. C. EMMETT,
Consul.

UNITED STATES CONSULATE,
Smyrna, January 15, 1890.

JERUSALEM.

REPORT BY CONSUL GILLMAN.

Refrigerators are not used in this consular district.

No peculiar features, however, would be required in the construction of refrigerators to adapt them for the use of this district.

Ice is not secured in this district, as it rarely forms, and then in insufficient quantity for the purposes referred to. About two years ago a company was formed at Jaffa for the manufacture of ice, but though the artificial article was of excellent quality the enterprise was not sufficiently patronized to prove remunerative, and after a few months' existence was, in consequence, abandoned. Underground cisterns abound in this country and where the preservation of foods and liquids is required they are let down into them and so can be kept for a sufficient time. The thick stone walls of the houses, keeping out the heat, also render refrigerators less necessary than in other warm countries. It is scarcely necessary for me to add that in the present state of things I could not recommend the introduction of refrigerators into this district.

HENRY GILLMAN,
Consul.

UNITED STATES CONSULATE,
Jerusalem, January 20, 1890.

SYRIA.

REPORT BY CONSUL BISSINGER, OF BEIRUT.

Refrigerators, in the American sense of the term, are not used in Syria, and until within about a year ago, were practically unknown.

Recently the Beirut Gas Company utilized part of its capacious plant in manufacturing artificial ice. The great heat in the summer and the distance of the works from the city suggested the necessity of providing some means of preserving the ice from too rapid evaporation or melting in transit and during delivery. A small number of wooden boxes were therefor constructed having two compartments, or rather one box placed inside the other with a vacuum of some six inches between the two; this space or vacuum is filled with either sawdust or cork, or both, the inside box—lined with zinc—containing the ice; it is perforated at the bottom to permit the escape of the water from the melting ice.

The dimensions of these boxes are about $4\frac{1}{2}$ to 5 feet long, $2\frac{1}{2}$ feet high, and $1\frac{1}{2}$ feet wide.

A small number of similar boxes, but of more diminutive size, were also made for the customers of the company and were either presented to them gratis to induce them to become clients or sold for a mere

trifle; their cost, the director of the gas company says, does not exceed from, say, 50 cents to $1 for each box. By this authority and others who are most competent to speak on such matters, I am assured that expensive refrigerators would not find a market here, and that anything costing over $1 or $2 could not be disposed of.

Foods and liquids are preserved in the most primitive manner by simply exposing them to the air, as houses are not provided with cellars.

The price of ice per 100 pounds is about $1, the competition with snow, which is a trifle cheaper, having forced the company to establish a low tariff.

Before the introduction of artificial ice, snow was exclusively used in this country and sold at much higher prices than ice does now; but, as people begin to prefer ice, its price has been forced slightly below.

The sale of both ice and snow is, however, very limited, the former not exceeding about 2,750 to 3,000 pounds daily during a period of about five or six months per annum.

From what precedes, it is obvious that American refrigerators could not be sold in this market, nor even so modified as to meet the local requirements of the immediate future.

ERHARD BISSINGER,
Consul.

UNITED STATES CONSULATE,
Beirut, January 20, 1890.

AUSTRALASIA.

REPORT BY CONSUL GRIFFIN, OF SYDNEY.

FOOD PRESERVATION.

Although much attention has been given for some time past by the Government and people of New South Wales to refrigeration and the various methods and appliances for the preservation of food, but little progress was made in the industry until about two or three years ago. In 1886 the New South Wales Government obtained information from the United States as to the methods and processes in use there for the preservation of food, and especially in regard to the transportation of fresh meat in refrigerating cars. Much of the information was obtained from the Department of Agriculture at Washington, and wide publicity was given to it by the New South Wales Government through the public press. Since that time several meat-preserving companies have been established with more or less success, and the governments of all the Australasian colonies have taken deep interest in the subject. The Government of Victoria, not long since, offered a premium of £300 ($1,460) for the invention of an economical means of cooling a chamber for the preservation of milk, cream, and butter, to be used on farms and at factories, and such as would reduce the temperature during hot weather to 50° Fahr. for ten hours without the aid of ice, chemicals, or machinery when the outside temperature would be not less than 120° Fahr. The Government also offered a premium of £300 ($1,460) for a machine of a cheap character which would produce like results; a premium of like amount was also offered for the invention of a chemical means to produce like results, such means to be of a cheap character readily applied. The same Government has also undertaken the erection of a number of cool stores for perishable produce at the various railway stations. Thirty of these stores are now in operation and forty-three others are in course of erection. Several methods were tried with the view of finding out the best design and materials. Trials were made in which terra-cotta lumber was largely used, but the result was not satisfactory. Finally it has been decided that the stores shall be built of wood, with double lining filled with charcoal for the walls, and shingle roof with charcoal ceilings. They are substantially built, and are fitted with thick doors, beveled and padded all round to make the openings air-tight. It is said that the temperature inside the sheds is from 20° to 30° less than ordinary shade heat outside. The stores cost between £300

($1,460) and £400 ($1,945) each, and already about £10,000 ($48,665) has been expended for this purpose. The question of artificial cooling in the storage sheds is under consideration, but the first object has been to create an insulated storage, where perishable products can be placed while waiting for carriage by railway in the refrigerating cars.

The cars that have been built in these colonies for refrigerating purposes can hardly be said to have passed more than the experimental stage, and there is, I think, a splendid opportunity for the introduction of refrigerating cars like those in use in the United States.

The use of ice in private houses in Australasia is comparatively of recent date. American processes for its manufacture have been adopted, and the industry may be said to be fairly started in all the large cities of these colonies. The cost of ice, until recently, was very high, but with the introduction of improved facilities for its manufacture the prices have been considerably reduced. The following are the present quotations: $0.73 to $1.22 per 100 pounds.

The Fresh Food and Ice Company, of Sydney, have recently erected a machine capable of turning out 60 tons of ice per day. Previously their ice plant, which was the largest in the colonies, turned out 20 tons per day. The ice is made on the ammonia-compression principle. This company's new machine has three 20-inch pumps, which draw sea-water from Sydney Harbor at the rate of 100,000 gallons per hour. The company's works include spacious cool-air chambers for preserving meat, fish, and dairy produce, and they have arranged for the sale of fresh fish in Sydney brought in the cool rooms of the Union Steamship Company's steamers from New Zealand. The following list will show the cost of the fish per pound in the Sydney market:

	Cents.
Blue cod	16
Butter fish	24
Flounders	18
Gurnard	18
Kippers (smoked)	18
Soles	24
Salmon	61
Salmon trout	61
Schnapper and bream	12
Trumpeter	24

The New South Wales Co-operative Ice and Cold Storage Company is another of the ice-making companies in Sydney. It was formed to purchase the plant of the Sydney Ice Company, which commenced business five years ago, having erected a machine upon the American Bath-Tevis patent. This machine, however, did not turn out well, and the company, after spending £30,000 ($145,995) was wound up voluntarily. One cause of failure has been put down to want of skill in the erection of the plant, another cause to unsuitable material having been used, the company having, as the secretary reports—

To save money, bought tubing and fittings in London, and the wrong kind of joints were obtained, namely, running sockets instead of tapering, and the black iron tubes butt welded (although they will stand a pressure of from 180 to 200 pounds, and are good of the kind, will not stand the extreme temperature) instead of double lap welded best steam tubing."

The secretary further states that the original company had imported a 6½-ton Guide machine, had altered the Bath-Tevis machine by applying it to ice-boxes, and had converted the large room used under the Bath-Tevis process into storage chambers. The new company has this season imported a third machine on the compressor principle. The ice supplied by this company is in 10-pound blocks, 9 inches square by 5 inches thick, and larger sizes as desired. The cold-storage rooms are largely used by butchers and others, who find it more convenient to send their goods into them instead of keeping refrigerators on their own premises.

An American machine called the "Picket" has been successfully introduced into Melbourne, and it is said several have been ordered for Sydney. It works extremely well. The only objection to it is that certain chemicals required for its use have to be imported here in copper vessels, the whole having to be prepared in the United States. No ammonia is used, the principal ingredient being sulphuric acid. The fact that the chemicals have to be prepared in the United States not only adds to their cost but renders it difficult to keep a regular supply on hand.

REFRIGERATORS FOR DOMESTIC USE.

Refrigerators were introduced in Sydney from the United States. The people were slow to take hold of them, but in time their use became more general. The number sold annually in Sydney is not large and does not probably amount to more than 500 or 600 per annum, one half of which are made in this colony and the remainder imported, chiefly from the United States. American manufacturers have some difficulty in competing with the locally made article on account of the cubic space occupied in transit to Australia, the cost of freight being thus rendered very heavy. If a refrigerator could be made so as to ship in what is called a knock-down condition it could be sold in these colonies at a much lower price. A machine for the manufacture of ice in small quantities is said to be greatly needed in Australia, especially in the smaller inland towns. Such a machine, however, ought to be supplied at a moderate cost. The refrigerators made here vary in size from 2 feet to 4½ feet in height and from 1 foot to 2 feet in depth and from 1 foot 9 inches to 3 feet 10 inches in width.

The following table shows in detail the sizes and kinds of refrigerators on sale here by one of the largest firms. The retail prices are also given in British and United States currency.

No.	Description.	Sizes.			Price.	
		High.	Deep.	Wide.	British currency.	United States currency.
		Ft. in.	*Ft. in.*	*Ft. in.*	£. *s.* *d.*	
1	1 cupboard, with shelf; also compartment for ice	3 0	1 9	1 9	3 0 0	$14.60
2	....do	3 0	1 8	2 0	3 15 0	18.25
3	1 cupboard, with 2 shelves; also compartment for ice	3 10	1 9	2 1	4 10 0	21.90
4	1 large cupboard, with 2 shelves; also compartment for ice	3 9	1 10	2 4	5 0 0	24.33
5	....do	4 0	1 11	2 10	6 5 0	30.42
6	2 cupboards, with shelves in each; also compartment for ice	3 4	1 8	3 3	8 15 0	42.58
7	2 cupboards, with 2 shelves in each; also compartment for ice	3 8	1 8	3 6	10 15 0	52.31
8	2 large cupboards, with 2 shelves in each; also compartment for ice	4 6	2 0	3 10	12 10 0	61.83
9	1 large cupboard on one side and 2 smaller ones on the other, both with shelves complete; also large compartment for ice in which can also be stored ærated waters	4 8	2 0	4 0	15 0 0	73.00

English manufacturers recommend a consumption of 40 pounds of ice weekly for their smallest refrigerators, ranging up to 150 pounds of ice weekly for the larger sizes.

In 1887 the firm of John Matthews, of New York, manufacturers of carbonated beverage apparatus and supplies, instructed Mr. I. B. Millner to place their refrigerating goods upon the Australasian markets. The portability, strength, and resultant purity of the "block-tin-lined steel fountains" made by this firm was apparent from the first and gained for them a place without difficulty. The introduction of their "draught apparatus," with its ice-box, coolers, etc., met with less favor until its peculiar features became known, when the economy of its working, in connection with reliability of its glass tanks, made it a favorite with the dealer, while his customer readily appreciated the pure, fresh coolness of the beverage produced.

These apparatus are now largely in use in each colony, while the steel fountains are to be found in the leading hotels and many private families, and are growing in favor as a means of developing a popular taste for the natural mineral waters of these colonies. The increased popularity of iced beverages is best shown by the numerous places opened for the sale of such, and the action of Mr. Milner in placing the waters of colonial springs before the public by means of apparatus especially adapted for the purpose can not fail to develop commercial value in what is now an idle element of wealth.

The locally made refrigerators are much heavier and not so well put together as the imported ones, but they appear to answer the purpose fairly well and sell at low prices. Indeed, it is often said that the high cost of the imported machines operates against their use. One firm of manufacturers at Adelaide, South Australia, are said to have succeeded in making a refrigerator at a cost of about one-fourth less than the least expensive of the ones imported. It occupies very little space. The

air is received in a compression-cylinder, subject to a pressure of 60 pounds, and is compressed to about 50 pounds to the square inch and forced through cooling pipes surrounded by water. It is reconveyed into an expansion chamber whence it is emitted at a temperature as low as 23° Fahr. above zero or 10 degrees below freezing point. The cool air is very dry and any snow that may be formed is collected in a snow chamber. The makers propose that this refrigerator shall be used on the railway cars and it can be run by a belt attached to the axle of the car.

The manager of the New South Wales Co-operative Ice and Cold Storage Company, in Sydney, informs me that a refrigerator suitable for the preservation of fish is greatly needed. He states that quantities of fish are regularly brought to the Sydney market packed with ice. They are generally in the boxes about forty-eight hours, but the boxes used are very clumsy and difficult to handle. The kind of refrigerator box which is needed is a portable one, suitable to convey the ice to the different fishing centers and be returned filled with fish. The sides of the box, he states, should be lined with some non-conducting material. It is said, however, that a still better plan would be to introduce American machines for the manufacture of ice in suitable quantities, on the spot, so that the fish and ice could be put into the boxes at the same time and place and conveyed to Sydney, instead of shipping the ice from Sydney and back again.

Several kinds of refrigerators, manufactured by L. H. Mace & Co., of New York, have been introduced in these colonies, the best known of which are the upright refrigerators. There are three sizes of this refrigerator: No. 1 is 19 inches long, 14½ inches wide, and 35 inches high; No. 2 is 25 inches long, 18¼ inches wide, and 40 inches high; and No. 3 is 31 inches long, 22 inches wide, and 45 inches high. The three sizes when nested and boxed for shipment occupy 19 cubic feet. The other styles are called the chest refrigerator and the excelsior chest refrigerator. The retail price is from £3 ($14.60) to £10 ($48.67).

Messrs. Hudson Bros., of Sydney, manufacture several kinds of refrigerators, chiefly from American designs. I am informed, however, that at present there is no large demand for them.

COOLING CHAMBERS.

Several cooling chambers, the invention of Mr. J. B. Witt, chairman of the Australian Ventilating Company, limited, have been erected, and they are in use at the Federal Coffee Palace in Melbourne, and at the Grand Central Coffee Palace in Sydney. They have given very general satisfaction. They are constructed on the dry-air principle. A fan or air-propeller is used, which draws the air from any given point and distributes it in the room at the ceiling. The air is distributed in a circular manner, so that there is a total absence of draught. The mechanism of the rotary fan is simple and inexpensive. Mr. Witt has also invented a con-

trivance for cooling the atmosphere by evaporation, and by this invention, when connected with the pipe attached to the air distributer, a low temperature is obtained. The dimensions of the cool chamber in the Grand Central Coffee Palace, Sydney, are 9 feet by 9 feet, and nearly the same height. The air in this chamber is cool enough to keep meat fresh. When it is desired to lower the temperature to 40° Fahr. or 45° Fahr., a small quantity of ice is placed in the refrigerator, through which the supply of air for the cool chamber is drawn. Mr. Witt claims that the superiority of this dry-air refrigeration system over the ordinary ice method is shown in the appearance of the meat, it being as bright and fresh looking as when placed in the refrigerator. Mr. Witt has successfully introduced his ventilating and cooling system in several churches, theaters, and other public buildings. He states that the means heretofore used to carry off vitiated air at or near the ceiling while introducing fresh air from below does not accomplish the desired results, for the reason that carbonic acid gas is much heavier than the outside atmosphere, its specific gravity being 1.524, or half as heavy again, and if an analysis were made the foul air would be found near the floor, owing to its specific weight. Under his system the fresh air is brought from the ceiling and forces out the vitiated mixture at the bottom. The pipes connected with the air distributer are carried through a chest containing ice and salt, which cools the air in transit and at the same time keeps it perfectly dry.

CHILLED-MEAT EXPORT.

The export of chilled meat, which for several years has been conducted at a pecuniary loss in most parts of the Australasian colonies, now seems likely to become a very profitable industry. The trade has made extensive strides during the year 1889, especially in New Zealand. Twenty-seven steamers and ten sailing vessels are now employed in the frozen-meat trade of that colony. Of the steamers, eight are under the flag of the New Zealand Shipping Company. The Shaw, Savill and Albion Line have built three new steamers especially for the trade, and these are marked with an asterisk in the following list:

List of vessels, with names and tonnage of each, engaged in the meat export trade of New Zealand:

Shaw Savill and Albion Line.—*Coptic*, 4,448 tons, 36,000 carcasses; *Ionic*, 4,753 tons, 36,500 carcasses; *Doric*, 4,784 tons, 36,500 carcasses; *Tainui*, 5,031 tons, 36,500 carcasses; *Arawa*, 5,026 tons, 36,500 carcasses; **Mamaria*, 3,583 tons, 36,000 carcasses; **Matatua*, 3,000 tons, 36,000 carcasses; **Maori*, 2,790 tons, 36,000 carcasses; total, 33,415 tons, 290,000 carcasses. The estimated voyages give this line of steamers 798,400,000 carcasses per annum. New Zealand Shipping Company.—*Tongariro*, 4,163 tons, 30,000 carcasses; *Aorangi*, 4,163 tons, 30,000 carcasses, *Ruapehu*, 4,163 tons, 30,000 carcasses; *Kaikoura*, 4,474 tons, 36,000 carcasses; *Rimutaka*, 4,474 tons, 36,000 carcasses; *Duke of Westminster*, 3,726 tons, 35,000 carcasses; *Duke of Buckingham*, 3,123 tons, 35,000 carcasses; *Duke*, 3,100 tons, 35,000 carcasses; total, 31,386 tons, 267,000 carcasses. The estimated voyages will give this line 728,400 carcasses per annum.

Tyser Line.—*Balmoral Castle*, 3,050 tons, 39,000 carcasses; *Ashleigh Brooke*, 2,863 tons, 38,000 carcasses; *Bayley*, 2,607 tons, 37,000 carcasses; *Star of Victoria*, 3,240 tons, 39,000 carcasses; *Star of England*, 3,511 tons, 41,000 carcasses; *Maori King*, 3,700 tons, 40,000 carcasses; *Celtic King*, 3,700 tons, 40,000 carcasses; total, 22,671 tons, 274,000 carcasses. This line also runs to Queensland, and the estimated voyages are reckoned to be equal to 348,000 carcasses from New Zealand per annum.

Martin Line.—*Elderslie*, 2,761 tons, 28,000 carcasses; *Fifeshire*, 3,720 tons, 28,000 carcasses; *Morayshire*, 3,720 tons, 28,000 carcasses; *Nairnshire*, 3,720 tons, 28,000 carcasses; total, 13,921 tons, 112,000 carcasses. This line is estimated to carry 224,000 carcasses per annum.

Of the ten sailing ships engaged in the frozen-meat trade, seven belong to the Shaw Savill and Albion, of the aggregate of 9,998 tons, with capacity for carrying 87,500 carcasses per annum, while only three belong to the New Zealand Company, carrying 34,000 carcasses per annum. The total carrying power affected to New Zealand, summarized from the above, provides for the transport to England in a single year of 2,220,300 carcasses.

The New Zealand meat export trade began in 1882, when she shipped 8,839 carcasses of mutton. In 1883 the exports rose to 120,893 carcasses; in 1884, to 412,349 carcasses; in 1885 they were 492,269 carcasses; in 1886, 655,888 carcasses were exported; in 1887, 766,417 carcasses, and in 1888, 939,231 carcasses; while in 1889, 1,063,506 carcasses were exported. Thus in eight years New Zealand sent to London no less than 4,459,392 carcasses of mutton, averaging in weight 85 pounds each. The result of the expansion of the frozen-meat trade has been to increase the price of mutton in New Zealand $0.61 per 14 pounds to $1.46 per 14 pounds weight. The Gear Meat Freezing and Export Company, of Wellington, New Zealand, paid a dividend last year of 10 per cent., increased its reserve fund by £2,500 ($12,166), and carried forward, after making large reduction in value of plant, £4,800 ($23,359). During 1889 upwards of 200,000 animals were slaughtered.

The supply of beef and mutton in the seven Australasian colonies is practically inexhaustible. The number of cattle in the entire group is about 11,000,000 head at the present date.

The subjoined table shows the number of sheep, horned-cattle, horses, and swine in the entire group of these colonies for the year 1888:

Colony.	Sheep.		Horned cattle.		Horses.		Swine.	
	No.	*Per cent.*	*No.*	*Per cent.*	*No.*	*Per cent.*	*No.*	*Per cent.*
New South Wales	46,503,469	48.15	1,622,907	17.49	411,368	27.35	248,583	21.80
Victoria	10,818,575	11.20	1,370,660	14.77	323,115	21.48	245,818	21.56
Queensland	13,444,005	13.92	4,654,932	50.17	324,326	21.56	68,994	6.05
South Australia	7,150,000	7.40	430,000	4.64	170,000	11.30	170,000	14.91
Western Australia	2,112,392	2.19	95,822	1.03	41,390	2.75	25,083	2.20
Tasmania	1,430,065	1.48	142,019	1.53	29,238	1.95	43,227	3.79
New Zealand	15,122,133	15.66	*962,200	10.37	*204,700	13.61	*338,500	29.69
Total	96,580,639	100.00	9,278,540	100.00	1,504,137	100.00	1,140,205	100.00

NOTE.—The figures for all the colonies, with the exception of New Zealand, are for the year ended March 31, 1889. In the case of New Zealand the number of sheep is for May, 1888.
* Estimated.

The estimated value for the same period of sheep, cattle, and swine in the seven Australasian colonies is given by Mr. T. A. Coghlan, government statistician for New South Wales, at £33,068,000 ($160,925,422),

of which £21,488,000 ($104,571,352) represents the value of sheep; £6,200,000 ($30,172,300) cattle for meat; £4,144,000 ($20,166,776), dairy cattle, and £1,236,000 ($6,014,994) of swine. It should be understood, however, that the greater part of the value of the stock returns is due to wool. Thus, out of the total quoted, about £17,100,000 ($83,217,150) is the value of wool. If the cost of freight, handling, brokerage, etc., were added the value of clip would amount to about £2,000,000 ($9,733,000) more. Mr. Coghlan, in referring to the food supply of the colonies, mentions that the meat consumed is greater in Australasia than in any other country in the world. He gives the consumption of meat in the colonies at 276 pounds per head of the population against only 69 pounds in Germany, 74 pounds in France, 115 pounds in Great Britain and 120 pounds in the United States; or, in other words, Australasia consumes four times as much meat per inhabitant as Germany and nearly three times as much as Great Britain, and more than twice as much as in the great wheat and meat exporting country, the United States. The surplus exported from Australasia forms only a small fraction of the quantity produced. The increase in cattle and sheep averages about 10.4 per cent. per annum. Of this, Mr. Coghlan states there is needed for the ordinary requirements of food supply, excluding exports, 9.4 per cent. of cattle and 6.8 per cent. of sheep, so that the net increase of the herds of Australasia is about 1 per cent. per annum, and of the flocks about 3.6 per cent. per annum. He says:

> Under the most favorable conditions—that is, if there were no losses from failure of food or water—the increase of sheep would be about 24.3 per cent., and of cattle 24.9 per cent., giving a net surplus of 17.5 per cent. and 15.5 per cent., respectively.

Mr. Coghlan, however, states that the frequency of droughts renders the increase of sheep only about 20 per cent., and that if steps are not taken to mitigate the effects of drought and to save part of the unnecessary waste of animal food, the demand for beef will eventually exceed the supply, but that the case is different with regard to sheep, as the supply is never likely to be seriously trenched upon, and a large surplus will always be available to meet the requirements of markets outside of Australasia.

In regard to the machine employed on steam-ships and sailing vessels for the export of meat, the Bell-Coleman and Haslem process appears to be most generally in use, although it is said that the Goodfellow machine is likely to take its place as it does not require to be kept running one-third the length of time. The American De La Vergne machine has also been successfully used, and is said to give very general satisfaction.

The new steam-ship *Matautis*, of the Shaw, Savill and Albion Line, is fitted up with Blythe & Passios refrigerators. There are three of these machines, two forward and one aft. The two forward are of 60,000 cubic feet and 40,000 cubic feet, and the aft machine is of 70,000

cubic feet capacity. The refrigerating rooms have a capacity for 30,000 carcasses of mutton, averaging 80 pounds each.

A considerable portion of the colonial frozen meat passes into consumption in the London market as prime English or Scotch mutton. It is found to be in a thoroughly sound and firm condition and would readily pass for the best home product. Objection is, however, being made to the article being sold as fresh meat. A bill has been introduced into the British Parliament to prevent its sale as such. The proposed bill provides that it shall not be lawful for any person to sell or expose for sale any foreign or colonial meat unless a conspicuous notice is placed over the shop indicating that foreign and colonial meat is sold there. It is further provided that no foreign or colonial meat shall be sold elsewhere than at these labeled shops unless notice is first given to the purchaser in writing to the effect that such meat is foreign or colonial, or unless the purchaser shall have expressly ordered or asked for colonial or foreign meat. Carts used for the conveyance or sale of such meat must also be marked, and there are other clauses of a similar nature.

In most of these colonies one of the principal obstacles to the successful development on a large scale of the frozen-meat export trade is the absence of a safe and convenient mode of bringing the meat to market in the dressed state. The cattle are usually driven through the country to a railway station, where they are shipped on the cars to Sydney; thence they are taken to the abattoirs on Glebe Island, situated not far from the city and sufficiently isolated and open to every breath of air.

The great attention now being given to the meat export trade of these colonies will unquestionably open up a wide and profitable field for manufacturers in the United States of processes and machines for the refrigeration and cool storage of meat, fish, and dairy produce.

Mr. Alexander Bruce, the chief inspector of stock for New South Wales, has favored me with an exhaustive report, under date of May 5, on the chilled-meat trade. From this valuable document I learn that it is now some eighteen years since the late Mr. T. S. Mort, of Sydney, to whom the Australian colonies and New Zealand are indebted for the establishment of the frozen-meat trade, endeavored to form a fresh-meat depot at Lithgow, 96 miles west from Sydney, and although himself unsuccessful in that enterprise, the trade in chilled meat has, in America, become firmly established, and is there supplanting the live-stock trade, as it will before long do in Australasia and throughout the civilized world. Mr. Mort's theory was that with the aid of artificial cold properly applied there need be no more waste, and the correctness and practicability of his proposals are fully borne out in the success of the chilled-meat trade, but more especially in that of the frozen-meat export from the Australian colonies, New Zealand, and America.

Mr. Bruce states that he has for the past ten or twelve years constantly advocated the establishment of a fresh or chilled meat trade,

both on account of the numerous evils which attend the existing live-stock trade and the advantages which must accrue from the change, and he very fully describes the evils of the live-stock trade and the suffering and cruelty inflicted on the stock. He says, speaking of New South Wales, that leaving out of view the hardships stock undergo in the outlying districts (where, as a rule, the feed is comparatively good) when traveling to the nearest railway station, and following them from the time they are yarded there till they are killed at the abattoirs, the treatment they receive in reaching Sydney from an outlying station like Bourke, 503 miles west from Sydney, is cruel and wasteful in the extreme, for they are between seven and eight days without any food, made up as follows:

In yarding, trucking, and despatching, say, from Bourke, 10 hours; on the cars to Homebush, near Sydney, unloading there and yarding, say 40 hours; lotting, selling, and removal to paddocks at Leichhardt, a suburb of Sydney, 15 hours; in waiting paddocks there (for as a rule the cattle purchased at one sale remain in these paddocks until next sale day, and a fresh lot have been purchased, before they are sent to the abattoirs), say, 84 hours; at the abattoirs waiting slaughter, say, 24 hours; total, 173 hours; that is, 173 hours, or 7 days 5 hours without any food, and sometimes without water.

It thus appears that a considerable portion of some 1,500 head of cattle and 15,000 sheep are week after week subjected to the terrible torture of five, six, seven, or even more days' starvation, till the cattle may be seen at the abattoirs with their heads hanging down, their bellies tucked up to their backs and looking utterly miserable and wretched. Nor is this all. The poor animals in trucking are terrified, beaten, and bruised, and when in the cars they push and horn each other, while the stopping and shunting often throw them down, and some are not infrequently trampled to death. The losses of cattle on the cars and the bruises so noticeable on their bodies when killed show conclusively the cruelty now inflicted on the animals under the live-stock trade and, as Mr. Bruce says, "with the terrible starvation which that system entails, cries aloud for a thorough change."

With reference to the waste and deterioration of the meat Mr. Bruce says that the shrinkage in weight alone is a serious matter; for if quiet, fat cattle in England, carefully driven short distances, and fed two or three times a day waste, on an average, over 8 pounds in twenty-four hours, it is certain that the loss in weight on the comparatively wild fat cattle of New South Wales must, till they reach the killing-pen, subjected as they are to the barbarous treatment and starvation from which they now suffer, waste nearly double that amount, and that the shrinkage in their case will amount to 12 or 14 pounds a day, which again for seven or eight days would on an average be at least 100 pounds per bullock, *i. e.*, one-eighth of the whole weight and the very best of the meat.

As to the deterioration in the quality of the meat, I learn from the

report that it is notorious the meat supplied in Sydney is, as a rule, inferior, tough, and void of flavor, especially in bad seasons. It is, in fact, after the cruelty and starvation to which the cattle are subjected, simply hard, well-trained muscle, with all the primest and most nutritious part of the meat gone, which not only renders it dear and innutritious to the consumer, but, so far as the beef is concerned, utterly unfit for export to London; while, as regards the frozen mutton now sent from Sydney to London, it on an average brings two-thirds penny per pound less than the mutton from New Zealand.

Mr. Bruce says the remedy for this unsatisfactory state of things is simple. It lies in the preservation of the quality of the meat by artificial cold, which can be obtained at a comparatively trifling cost. On or near its own pastures the meat is as good as any in the world, and if only conveyed from the pastures to market without deterioration it is an article in every way fit for local consumption and can be offered with confidence in any market, either in a fresh, frozen, chilled, tinned, or salted state.

Mr. Bruce's recommendations are:

(1) To kill the stock at the main centers of the stock traffic on the railways, as near the pastures on which they are fattened as possible; or, if they have traveled any distance, to keep them in paddocks near these centers where they can get plenty of good grass and water for six, eight, or even more days, till they are well rested and cooled down and thoroughly free from fever.

(2) To send the meat, with as little handling as possible, to a chilling-room cooled down to 36° F. in winter and moderately cool weather; and in the summer time down to 33° F. (just above freezing), in order to have a good surplus of cold to meet the loss which takes place in the transit when the weather is warm, and thus do away as far as possible with the necessity for providing ice by the way. The meat for consumption in Sydney could in this way afford to lose, say, 30° F. (the car would then only be 53° F.), and arrive perfectly safe. The cost of chilling would in the height of summer be, say, 61 cents per body of beef from Bourke or Hay, with the temperature at 100° F. in the shade.

(3) To put it late in the day into non-conducting meat cars (which would also be cooled down to the temperature of the meat, and send it by train at a speed of at least 20 miles an hour to market; and

(4) To run the cars, on reaching Melbourne or Sydney, into a meat market provided with the necessary appliances for cooling and keeping the meat, and there, according to the state of the market, either dispose of it to the retail butchers, send it to the chill-room (where it can be kept perfectly sound far a fortnight) to wait a better market, or prepare it for exportation as frozen, chilled, tinned, or salted meat.

A proper chilled room to protect the meat should it not be sold on arrival is a *sine qua non*. It was the want of this that was one of the principal causes of the failure of the Orange Company to establish a

fresh-meat trade, for as the company had no means of protecting the meat when not sold, they had to take the price offered by the retail butchers or allow it to stink. They were, in fact, largely at the mercy of the trade; whereas with a proper chill-room the salesman could put the meat in and wait a fortnight if necessary for better prices, to say nothing of the other outlets secured by a proper system of artificial cold.

In reporting on the success of the fresh-meat trade in the United States Mr. Bruce acknowledges the assistance the project derived owing to information obtained from America in the following words:

Mr. Gilderoy W. Griffin, consul for the United States, who has done so much to make our resources known there and to promote trade between the colonies and America, kindly obtained from the Commissioner of Agriculture, Washington, an exhaustive and very valuable report on the fresh-meat trade in the United States, which showed that the fat-stock trade in America, in spite of the powerful vested interests which exist there, was fast becoming a fresh-meat one. In the short space of six years the volume of the fresh-meat trade from the Western to the Eastern States of America, which only began in 1880, had increased with great rapidity, and has by this time overtaken and passed that of the live-stock trade; and the Commissioner of Agriculture in reply to the question whether the fresh-meat trade is likely to increase very tersely observed that, "it must continue to increase unless there should be a revolution in trade affairs and in the desire of the people to obtain the best meat for the smallest outlay," a contingency which it would be simply absurd to suppose would ever arise.

I learn that during the five years from 1881 to 1885 the growth in dressed meat was: From 1881 to 1882 the increase was 42.5 per cent. over the trade of 1880; in 1882 the gain was 52.3 per cent.; in 1883 it was 127.5 per cent.; in 1884 it declined to 23.6 per cent.; and in 1885 it was 25.2 per cent.

The Mark Lane Express, London, in January last, says:

The dressed-beef business has driven the carcass-butcher out and is the coming method of handling beef in America.

And the Daily News, London, says:

There are enormous numbers of us able to regale ourselves on the roast beef of old England brought straight from Chicago.

As to the success of the fresh-meat trade in Australia in 1889–'90, Mr. Bruce says that it is still asserted by some in the meat trade that though the system has proved a success in America it may not answer in Australia, but that fortunately it is not necessary to be dependent on American experience, for through the energy and enterprise of Mr. Robert Hudson, of the firm of Messrs. Hudson Brothers, of Sydney and Melbourne, the reports of the success of the fresh-meat trade in America have been fully confirmed by the experimental trips he has made with his refrigerating cars from Narrandera and Narrabri to Sydney, which were thoroughly successful, not only as regards the condition of the meat on its arrival in Sydney, but also as regards expense and the owners' net returns.

With the view of showing the advantages still more clearly Mr. Bruce supposes a case where two fat bullocks of the same weight at Bourke are sent to Sydney. One of them is sent alive and sold at Homebush, and the other killed and chilled at Bourke and the carcass sent, with the profitable offal, by refrigerating car to the meat market, Sydney, by which means, he states, there is a saving of at least 10*s.* ($2.43) per bullock to the owner, while the indirect advantages to the stock-owner, owing to the superior quality of the meat and the price it will bring in the London market if frozen and shipped, are of great moment.

KILLING AND CHILLING DEPOTS.

With regard to who should erect killing and chilling depots Mr. Bruce advocates the construction of these depots by joint stock companies, formed to a considerable extent by trades-people in the towns near which the depots are to be established, but principally by the stock-owners in the areas from which the stock would be brought to the depots for slaughter and chilling. He would have these companies to act as agents for the stock owners and dealers, take delivery of the stock and kill and chill them, forwarding the carcasses on owners' account to market in the refrigerating cars, for which they would supply the ice when required, charging a moderate amount for their services, which would to some extent be paid for in offal.

Mr. Bruce has consulted one of the leading mechanical engineers in Sydney, who has given the question of cost special study both in Australia and in America, and he understands that the cost of the necessary buildings and of a complete chilling and ice-making plant, together with yards, slaughter-houses, land, etc., for an establishment capable of dealing with, say, 120 cattle or 1,200 sheep a day, and supply the necessary ice for transit, would be £12,000 ($58,398), while the working expenses of such a depot, including interest on cost of plant, wages, coal at £2 per ton, water, ammonia, sundries, etc., would bring the cost of chilling a body of beef weighing say, 800 pounds, to 48 cents.

On the question as to who should provide the refrigerating cars Mr. Bruce says, while it is taken for granted that the trades-people in the more important towns will co-operate with stock-owners in the surrounding country to form companies for the erection of killing and chilling depots, he believes that the Government railway commissioners are the proper body to supply refrigerating cars, the companies not only supplying the cold for chilling the meat, but also the ice for keeping the cars cool. He states that an endeavor was made to form a metropolitan company to rent the meat market and chill-room in Sydney from the railway commissioners and, where necessary, to assist the up-country killing and chilling companies in the construction and working of their depots.

The promoters of the Metropolitan Company also proposed that they

should find the refrigerating cars, that the cars should be hauled by the railway authorities at a stated rate per ton, and that the railway commissioners should have the use of the cars for back loading.

Mr. Bruce, however, points out several objections to this arrangement and among others mentions the following:

(1) It would take a great deal of capital to provide the necessary cars, and shortness of funds is one of the principal drawbacks to the formation of the proposed Metropolitan Company.

(2) The question of who should make the repairs to the cars would be a difficult one to settle, and it would, I am afraid, be at times impossible to say who should do so.

(3) The Commissioners would be able, besides conveying the fresh meat, to make much more use of the refrigerating cars than the company in carrying milk, dairy produce, fruit, and game to Sydney, and fish and other perishable articles up country.

REFRIGERATING CARS.

Mr. Arthur G. Kenway, superintendent engineer in charge of the New South Wales Government works connected with the meat trade, has furnished me with an account of an experimental trial of a refrigerating car designed by him. He states that his method consists in placing meat chilled in simple insulated cars, without ice or other artificial cold-producing agents, trusting simply to the insulation of the cars and the cold stored in the meat to effect the purpose for the shorter distances, and for those longer to recharging the cars with cold air at intervals from stationery machinery if found necessary.

The car which Mr. Kenway designed was divided into three sections, the first containing the refrigerator; the second was the insulated chill-room; the third section contained a tank of a capacity of 750 gallons. The refrigerator was one of the Bell-Coleman and Hastem pattern, dry cold-air machines, capable of discharging 5,000 cubic feet of cold air per hour. It was connected with the boiler of the locomotive by a flexible rubber steam-pipe, and it discharged its cold air into the insulated chill-room, the walls, floor, and ceiling of which were built in the manner Mr. Kenway proposed should be done for the permanent insulated cars, with 5 inches of woolen flock packed between two inner and two outer thicknesses of 1-inch tongued and grooved pine boards which had a layer of paper felt between them, except on the floor, which had a layer of waterproof paper instead.

If chilled meat had been procurable up country, Mr. Kenway states, a simple insulated car would have been all that was necessary for the experiment. The meat, namely, six quarters of beef and five bodies of mutton, was previously chilled by the cold-air process at a private establishment in Sydney in order to economize time, and was put into the car shortly before leaving Sydney on Sunday night, the 17th of March. A start was made at 9 o'clock, and the refrigerator in the car was kept

at work for a period of sixty-five minutes. The meat and the room then showed a temperature of 30° Fahr. The machine was then stopped until Nyngan was reached, a distance of 343 miles. This portion of the journey occupied twenty-two and one-half hours. A number of delays occurred before the car reached Bourke, 503 miles from Sydney, where the temperature was found to stand at 50° Fahr. The temperature outside the car during the greater part of the trip varied from 57° Fahr. to 80° Fahr., and while traversing the plains the thermometer ranged from 80° Fahr. to 98° Fahr. on the sides of the car, in the shade, while in motion. On the return journey the temperature was reduced to 30° Fahr. before leaving Bourke, and from that time until Sydney was reached the machine was never used. The meat when removed from the car was found to be in prime condition, firm and cool, its temperature being 46° Fahr.

The most desirable temperature for meat to stand at when delivered is believed to be 60° Fahr., so that the journey might have been continued eight or ten hours further with safety. Mr. Kenway states that the results of the experiment show that it is possible to convey chilled meat in simple insulated cars for the longest journeys in New South Wales without the aid of any refrigerating appliances during the hottest weather if the meat is properly chilled before being placed in the insulated cars, the temperature in which being reduced to 30° Fahr., the explanation being that sufficient cold is stored up in the chilled meat to answer all requirements on the journey.

It is doubtful whether the Government will construct cars on this pattern, as it is believed they are too heavy and expensive.

The Messrs. Hudson Brothers, who have constructed several refrigerating cars for the Government railways, are taking steps to introduce into Australia refrigerating cars made by the Wikes, the Zimmerman, and the Riordan Manufacturing Companies, of Chicago, Ill. The Messrs. Hudson Brothers had on exhibition at the Metropolitan show near Sydney on the 7th April last, a chill-room similar to those they propose to erect in the country districts. A number of sheep killed at Bourke seven days previously were brought to the Metropolitan show and hung up in this chill-room. The fine condition of the meat and the ease with which it was conveyed to Sydney were subjects of commendation by those interested in the exhibition. The Messrs. Hudson Brothers state in a communication to me that they have had much difficulty in selecting a suitable machine for the manufacture of ice; that they have visited every place where these machines could be procured in Europe and America, but up to the present time not one seemed to answer their purpose. They state:

> Our great effort has been to find an economical machine which we could use in connection with the chill-room. The machines with which we are most pleased are the Goodfellow and the Kilbourn & Co. The latter is an American machine and will probably be adopted by us.

The Messrs. Hudson Brothers state that the De la Vernne machine is a good one, but very costly and scarcely suitable to take a long distance into the interior of this continent.

G. W. GRIFFIN,
Consul.

UNITED STATES CONSULATE,
Sydney, May 6, 1890.

NEWCASTLE, N. S. W.

REPORT BY COMMERCIAL AGENT DAWSON.

The majority of freezers in use in this consular district are of American make. There is no great quantity of them nor any great demand for them, but the leading hotels and restaurants have them, and some private families. Their size varies from 3 feet 6 inches by 2 feet 6 inches, to 5 feet by 3 feet 6 inches, *i. e.*, the size of the box. Those used in restaurants have cooling ovens with ice chambers at the top and water chambers at the sides. Those in hotels are shelved off for holding liquids, bottles, etc. They cost from $25 to $75. Ice is imported from Sydney at present, and retails in 14-pound blocks at 36 cents per block. It probably costs the importers 75 cents per 100 pounds in Sydney. There was an ice manufacturing establishment here, but it collapsed. There is room for another. Refrigerators are brought here from Sydney, but there is no reason why they should not come direct from the United States.

THOMAS M. DAWSON,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Newcastle, February 13, 1890.

NEW ZEALAND.

REPORT BY CONSUL CONNOLLY, OF AUCKLAND.

The subject of refrigerating machines is one of considerable magnitude in New Zealand, embracing as it does one of the most important industries of the colony. I found at the outset that in order to obtain thoroughly reliable information I must visit a few of the great "freezing works" in several localities throughout the country.

All the refrigerating machinery used in New Zealand is manufactured in England, and is known as the "Haslam dry-air refrigerator," and is used exclusively for freezing beef and mutton for export to the London market.

Owing to the fact that there are no small freezing machines in use in this colony, the people are of course unfamiliar with the benefits to be derived from the use of the smaller refrigerators as used in the United States.

As to the best means of introducing American refrigerators, I find is a most difficult matter to suggest a practical method of doing so successfully, for many reasons. The American refrigerators are comparatively unknown in this colony, and until their superiority is established beyond any possibility of doubt the people would be slow to favor them, especially as there is an impression prevalent here that American refrigerating machinery is not adapted to the use most required here, viz, meat freezing. Those who are engaged in this business, and presume to be familiar with all the necessary requirements of the trade, claim unhesitatingly that the American refrigerators could not be utilized as economically or as advantageously as the English-manufactured machine. Consequently, in view of the prejudice that already exists against the American machines, it would, as I have already stated, be difficult to advise intelligently concerning the successful introduction of our American-made refrigerators.

Perhaps the most economical manner of introducing some of the smaller refrigerating machines for the preservation of food and liquids would be for some of our American merchants who have correspondents in this colony to ship a few sample machines to such correspondents with full and complete instructions. This I have no doubt would be much the cheapest and least expensive way. But a far more satisfactory method would be to send a duly authorized agent with the machines one who would be capable of publicly demonstrating the capacity and utility of our American refrigerators. This would undoubtedly be far the most desirable and practical manner of bringing out machines successfully

and satisfactorily before this public. The advantages derivable from an authorized agent presenting the machines as compared with those of a local resident agent are numerous and must readily suggest themselves to the manufacturer. The American agent would thoroughly understand his business, and for this reason would inspire the public confidence while the resident agent would be ignorant of the proper methods employed to produce the most satisfactory results, thus practically destroying in the beginning whatever chance there might be of introducing our American-made machines. No matter how meritorious the machine may be the uninitiated when testing it under the gaze of a prejudiced and critical public might fail utterly. Therefore, if ever an effort is made in this direction, I would strongly urge the unmistakable necessity of sending a thoroughly reliable and practical person to represent the goods, as much will depend on the ability of the representative, presuming, always, the machines are useful and adapted to the requirements of the people of this colony.

The manufacture and sale of ice in this colony is very limited indeed. Machinery intended for the manufacture of ice alone would not in my opinion pay here. Ice is not used in any considerable quantities, as the climate in most parts of New Zealand is mild and equable, and in consequence of this the necessity for ice is correspondingly reduced. Whatever ice is required is procurable from any of the "freezing works" throughout the colony and at very reasonable rates, considering that none are manufacturing it specially for sale. Ice is obtainable at the rate of 1 cent per pound.

The following will afford some idea of the size, cost, and capacity of a few of the refrigerators in use in this consular district.

In the Christchurch district there are two meat-freezing establishments, both of which machines are manufactured by Haslam & Co., Derby, England, as, indeed, are all the machines used for freezing purposes in the colony. I will give the size and power of one of those in use in Christchurch, which will suffice for both. One of these machines is capable of delivering 110,000 cubic feet of cold air per hour. The cost of this machine in England was $18,248.87.

There are also two freezing works in the Wellington district. The Gear Meat Preserving and Freezing Company of Wellington have two machines, each capable of discharging 45,000 cubic feet of cold air per hour. The cost free on board in London was $13,139.55. This company will have an additional machine in about two months hence, with a capacity equal to 150,000 cubic feet of air per hour, which will cost, including condensers, free on board, London, $21,899.

The Wellington Meat Export Company have three refrigerating machines in constant use. Two of these machines deliver 120,000 cubic feet of cold air per hour, at a temperature of about 70 degrees below zero at the point of discharge. The third delivers about 50,000 feet of air at about the same temperature. The two larger machines will

freeze 500 sheep per diem, while the smaller will only freeze about half the above number. They are all air-compression machines. The larger ones cost in London $17,032, while the smaller one would be supplied now for about $10,949.32.

This company has been sending away for the last six months an average of 1,100 cattle and 17,000 sheep per calendar month.

It may be said of all the machines used in this colony for meat freezing purposes that no special or pecular features are required, except that they have to be adapted to freezing large quantities of meat in a short time. None of these machines are used for chilling or storing meat for local consumption.

It may be somewhat interesting to many to get a pen picture of one of these great meat-freezing works and the *modus operandi* of meat-preserving and the disposition made of a sheep from the time it enters the slaughter-house until the final process is gone through with. For this purpose I will select the freezing works of Nelson Brothers, at Tomvana, near Napier, N. Z., commencing with the slaughter-house, which is a long shed where the sheep have arrived at the "sticking point" and come under the hands of twenty butchers who are busily engaged killing, skinning, and dressing them. Through this shed runs a miniature railway, which takes away the fat to the boiling-down house, the skins to the fell-mongery, the intestines in due time becoming fiddle-strings to charm or torture as the fates decree. Overhead are a number of rails on which run friction rollers, to which the carcasses are hooked, and here they begin the long journey which is to end in London. Along these rails they are rolled into the cooling-room, in which they remain till all their animal heat has been expelled, when they are passed into the refrigerating chambers, where they are frozen for thirty-six hours, by the end of which time they give out a bell-like sound when struck. From these chambers (which hold from 200 to 600 carcasses) they are removed to storing-rooms, and in due course are taken away to the port of shipment in specially constructed railroad cars; 1,400 sheep can be prepared per day, and there is storage for 40,000 carcasses.

From the slaughter-house we pass to the boiler-house, in which we find, in addition to four 20 horse-power boilers, a striking novelty in the shape of a 60 horse-power Babcock and Wilcock boiler, in which the steam is generated in groups of tubes between which the heat from the furnace circulates, which tubes depend from a horizontal steam-drum mounted on trunions at its ends, which arrangement allows for an unequal expansion of the parts, the drum being luted to the brick setting inclosing the tubes. The flues of all the boilers lead into one of "Green's Economizers," containing 168 tubes 12 feet long and 4 inches in diameter, for heating the feed-water which is passed through them on its way from the condensers to the boilers, and is thus heated by the waste heat circulating between the tubes.

Adjoining the boiler-house is the refrigerating machine. Here are

four Haslam dry-air refrigerators busy at work, in which the air on its way to the freezing chambers is first heated by compression, then cooled by passing through pipes surrounded by cold water, and then passed into a chamber containing dry-air pipes. After passing through these pipes the air is expanded, by which means its temperature is reduced to 80° below zero. It then passes through air trunks into the freezing chambers, and, after doing its duty, passes back through exhaust trunks to the compressors. In the freezing chamber the cold is indeed most intense—frost on the roof, on the walls, on the floor, and here and there a little snow. In this chamber are countless carcasses undergoing the freezing process.

The engine-room and freezing-chambers are lighted at night by a Siemens electric light, the dynamo for which is driven by a 3 horse-power engine.

Leaving the engine-house we pass two large reservoirs, from which 700,000 gallons of water are daily passed through the machines.

Entering the wool-shed, here is an invention which will probably revolutionize all those processes in which wool requires to be dried after being washed, dyed, etc. Sheep-raisers, fellmongers, wool-scourers, and dyers have long sighed for some inexpensive and efficient apparatus which should render them independent of the weather and enable them to do their work with satisfaction, precision, and absolute certainty. This desideratum is at last supplied in these patent wool-drying machines, two of which are here at work, and by which the wool to be dried is exposed to a blast of warm air so that its fibers may be repeatedly acted upon thereby and thus be regularly and rapidly dried, the dried wool being expelled from the machine by means of the blast. Each machine consists of a sparred drum, open at both ends and revolving on friction-rollers in a casing, between the bars of which (drum) air is forced from a longitudinal air-trunk. The interior of the drum is furnished with sparred shelves which, as the drum revolves successively, take up portions of the wool and allow them to fall, and thus expose them fully to the current of air, and also shake out any dust or other foreign substance, which in itself is a great advantage. Both drums are 8 feet in diameter, one being 14 feet long and the other 30 feet. The shorter drum is worked intermittently; that is, a charge of wool is thrown in at one end and when dried is blown out at the other by turning on a blast. In the longer drum the feeding and discharge of the wool are carried on continuously, the wool fed in handfuls through a hopper at one end, and the blast from the air-trunk being directed by means of adjustable "feathers" on to the wool in an oblique direction, so that the blast both dries and propels the wool through the drum. The apparatus, which is exceedingly simple in construction, can in two hours be taken to pieces for transmission, and as readily set up on its arrival at its destination. Upon examination the dried wool is found to be of an extremely silky luster. I have devoted considerable space to

this "wool-drying" apparatus in the hope it may be interest to the wool-growers and others interested in the wool industry in the United States.

One noticeable feature around these great meat-preserving establishments is that there is positively no waste. Everything fit for human consumption is utilized and prepared in the most careful and painstaking manner. Thus the skins of the refrigerated sheep are cured for subsequent manufacture into parchment, "morocco," and "roans;" the clippings from the pelts are washed and dried by patent machines already referred to and turned out as short wool; the kidneys, tongues, etc., are tinned, and even the horns and bones of the bullocks are sent to the bone-dust factory to be ground, and thus again assist in the production of additional comforts for mankind. In my description of the cooling chamber I find I have omitted some important details. The cooling-room is constructed with a double ceiling, through which a current of air is drawn by a fan driven by a donkey-engine. In this cooling-room the carcasses are permitted to remain for 10 hours, when all the animal heat has been expelled. The carcasses are then placed in the refrigerating chamber, the walls, floors, and ceilings of which are insulated with a charcoal lining, and the cold-air is supplied through an inlet air-trunk direct from the engine, and afterwards passes back to be cooled down and used over again. By this means there is a constant circulation of cold air thoughout the freezing-chamber.

All the steamers and sailing vessels plying between England and New Zealand and engaged in the frozen-meat carrying trade are supplied with Haslam refrigerators. It is asserted that 95 per cent. of all the frozen meat placed upon the London market is treated by the Haslam process.

There are seven refrigerating machines in the Auckland district, with a capacity ranging from 2,000 to 120,000 cubic feet of cold air per hour.

The cost of the smaller machines is about $3,400 each, while the cost of the larger machines, those capable of discharging 120,000 cubic feet of air per hour, is $17,032 in England.

There are ten large meat-freezing establishments in the colony and about five smaller ones, as near as can be ascertained. The total number of Haslam refrigerating machines in use in New Zealand for meat-freezing purposes are twenty-six. It is asserted by all who are interested in the frozen-meat industry that "the American ammonia machines" are useless for meat freezing, consequently could not be sold here at any price for meet-freezing purposes.

JNO. D. CONNOLLY,
Consul.

UNITED STATES CONSULATE,
Auckland, May 9, 1890.

WEST AUSTRALIA.

REPORT BY CONSULAR AGENT SANDOVER, OF FREEMANTLE.

Refrigerators are not used in this district, ice at the present time not being manufactured here. From my knowledge of the American refrigerators I believe that when ice is manufactured here, which will be when the population becomes larger, these refrigerators will be the most suitable kind for the place.

Regarding the best manner of introducing them, I think the best way would be to instruct the manufacturers to send circulars and prices to this consular agency, and I would see that they were distributed among dealers.

WILLIAM SANDOVER,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Freemantle, March 6, 1890.

POLYNESIA.

FIJI.

REPORT BY COMMERCIAL AGENT ST. JOHN, OF LEVUKA.

There possibly may have been a half dozen refrigerators brought here from England several years ago when the colony was more prosperous, but on account of the impossibility of getting ice they have gone into disuse.

Ice is at present manufactured in very small quantities and at very irregular intervals. The price demanded for it is 12 cents per pound or $5 per hundred-weight.

As to the conditions which prevail relative to the preservation of foods and liquids, it is the very simple way of placing them in a well-ventilated safe (usually of wire netting) and placed in as cool a shade as possible, either under the shade of the house or of trees as most convenient.

No attempt is made, however, at keeping them for any length of time.

As to whether American refrigerators could be so modified as to meet the local requirements in the absence of ice, I am unable to say.

In consideration of the small trade that could, even under favorable circumstances, be realized in this colony, I could only suggest but one way for the introduction of refrigerators here, and that would be through New Zealand or the Australian colonies. That is, that they be re-shipped from houses dealing in such goods in those colonies to this colony of Fiji.

ANDREWS A. ST. JOHN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Levuka, April 9 1890.

HAWAII.

REPORT BY CONSULAR AGENT FURNEAUX, OF HILO.

Refrigerators are in use by the foreign families resident in this place. The ordinary kind, such as are in common use in the United States, fully meet the requirements of this community. Those in use here are manufactured in San Francisco, Cal., and in Buffalo, N. Y.

The average size is 2 feet 6 inches by 2 feet 10 inches; height, 3 feet 8 inches outside measure.

Ice is manufactured here and furnished at $3 per 100 pounds. The machine in use was made in San Francisco.

CHAS. FURNEAUX,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Hilo, February 10, 1890.

CONTINENT OF EUROPE.

AUSTRIA.

REICHENBERG.

REPORT BY COMMERCIAL AGENT HAWES.

No refrigerators are for sale here. Owing to the cold climate, they are little needed and are either made in a primitive manner by a carpenter or are ordered from Prague or Vienna. As they are only in the possession of private parties, it is impossible to procure any valuable information on the subject. Reichenberg is too small a city to do any direct importation from the United States, but perhaps if American refrigerators were introduced in Prague and Vienna, a limited number would be ordered here. The demand, however, would be so small that I am convinced that a couple of dozen would meet the demand for a a year.

Consignment to responsible firms would be the only way of introducing such articles to the trade in this city.

JNO. B. HAWES,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Reichenberg, April 11, 1890.

TRIESTE.

REPORT BY CONSUL HARTIGAN.

Refrigerators are used everywhere in this consular district. They are mostly made in Germany, Austria, and a few in Trieste.

The natural ice for local use and export is obtained from the surrounding mountains (Karst), small lakes, rivers, etc.

There is one establishment for the manufacture of ice, that of Heinrich Ritter von Zahony, where the ammonia process is employed; Linde patent.

The population of the Karst being extremely poor, ice is sold by them according to the season, between 20 and 40 soldi per 100 kilos, or an average of about 7 cents for 100 pounds. The artificial ice is considered a purer quality and commands a price one-third higher.

The system in vogue by butchers and others for preserving meats, etc., is somewhat similar to that in the United States.

Verderber & Co. are the principal agents and dealers here in refrigerators; they are enterprising men, and the best way, in my judgment, for the introduction of American make would be through them, if they were furnished with an illustrated catalogue of some large manufacturer, giving full particulars, dimensions, prices, etc. The price, I need not say, is an important consideration to compete with European production.

JAMES V. HARTIGAN,
Consul.

UNITED STATES CONSULATE,
Trieste, January 24, 1890.

BELGIUM.

ANTWERP.

REPORT BY CONSUL STEUART.

Refrigerators are used in this consular district not so generally, probably, as they would be in a city of the same size in the United States, but an appreciation of their convenience seems to be growing, and may increase the demand for them. It is difficult to say about how many are sold, but a dealer who handles more than any other one in the city told me he disposed of say from forty to fifty a year.

Those on sale here are manufactured in Germany, and are constructed similar to those in use with us at home. As they are of comparatively recent introduction, they are, I am sure, imitations or copies of those made in the United States and exported to Germany. The formation, therefore, is almost the same; the sizes range, according to a German price-list that I saw, from 50 by 65 by 76 centimeters to 88 by 185 by 188 centimeters. Then there are extra large sizes made for the use of restaurants and hotels, and also others constructed to hold beer in the keg or barrel, the smaller ones with single door and shelf, the larger ones with double doors—shelves on one side. They are made of wood, painted, and lined with zinc.

The ordinary sizes for family use here range from 50 by 65 by 76 centimeters, to 60 by 100 by 110 centimeters. The cost price of the former is 28 francs or $5.40, and the larger 82 francs, or $15.82 delivered in Antwerp. Extra large-sized ones are sold at from 200 to 275 francs by the retailer.

It is obvious that as price must be the main consideration in the effort to introduce the American refrigerators on this market, it will be necessary for the manufacturer to satisfy himself that he can place his product in successful competition with those now on sale here. It must be done at a price that will enable the dealer to sell as low or lower than he does his German ones, and find as much profit in them. An advance in price on account of any claim for superiority in any particular, however well-founded, will have no effect. They will buy the cheapest and remain true to them until convinced by experience in the use of others that they are as good or better than the ones they have been accustomed to.

In regard to the manner of introducing any goods upon a foreign market, there are several ways—as, for instance, by personal effort of an agent sent for that purpose; by sending a consignment of the goods, if a dealer, can be found to receive and offer them; by procuring the names of parties dealing in the goods; and then by means of corre-

spondence and circulars or price-lists printed in the language of the country, inducing them to make a trial. In the latter method the consul can and is often called upon to give the names of parties in his district engaged in the various branches of trade.

The small quantity of natural ice gathered during the winter is of no importance, and manufactured ice is in general use. There is a large company here engaged in that business, and the price is about 10 francs per 500 kilograms or $1.93 per 1,000 pounds. They furnish tickets to families, 25 tickets, at a price of francs, 12.50, each ticket calling for 25 kilograms of ice.

JOHN H. STEUART,
Consul.

UNITED STATES CONSULATE,
Antwerp, January 28, 1890.

BRUSSELS.

REPORT BY CONSUL ROOSEVELT.

Although the use of refrigerators is yearly increasing in this consular district, the general use of same is considerably less than in any section of the United States.

Refrigerators for this market are of domestic and foreign manufacture, made of various kinds of woods, in all sizes and forms, without any special or peculiar features, but more or less imitations of American refrigerators. Prices for domestic production varies from 46 to 200 francs each, according to size and quality of wood. English refrigerators vary from 45 to 150 francs, and the German article from 46 to 160 francs each.

Different varieties of refrigerators are employed here in breweries for cooling beer. The most popular are the Schmidt, Mennig, and Briggs. The Schmidt patent is most generally used in this consular district.

Upon inquiry at the different establishments dealing in refrigerators I discovered only one firm, C. Duhot & Co., No. 3, Vieux Marcheaux Grains, Brussels, willing to accept an agency for the sale of American refrigerators. Mr. Duhot stated that, some years ago, he introduced American stoves on this market; that he is more than satisfied with the result of the venture, as the demand for this merchandise steadily increases. He is consequently favorably disposed to handle American refrigerators, provided American manufacturers are inclined to furnish said goods at equally advantageous rates as English and German producers.

I would suggest, as the most practical and satisfactory manner of introducing American refrigerators on this market, that manufacturers send samples of goods and arrange to have them presented to trade by intelligent, active agents, having a perfect knowledge of the French language.

ICE SUPPLY.

Ice for domestic consumption is largely procured from natural ponds and lakes in the provinces of Brabant, Hainaut, and Namur, large quantities are manufactured at the several ice-manufactories situated at Brussels, and a small amount is annually imported from Holland.

Price for ice for domestic use, 8 francs ($1.54) per 200 pounds. Wholesale price, 5 francs (97 cents) per 200 pounds.

I inclose cuts of different refrigerators in use here.

Nos. 1 and 2, refrigerators for preserving food. No. 3 Mennig, No. 4 Briggs, Nos. 5 and 6 Schmidt, for cooling beer.

DESCRIPTION OF SCHMIDT PATENT.

The Schmidt refrigerator is manufactured at Bretten, Baden. It has a cooling capacity from 8 to 40 hectoliters per hour. It is made of the best sheet brass, plated with pure tin. This apparatus consists of three parts, as follows: (1) Distribution pan, C; (2) reeded cylinders, D; (3) receiving basin, K.

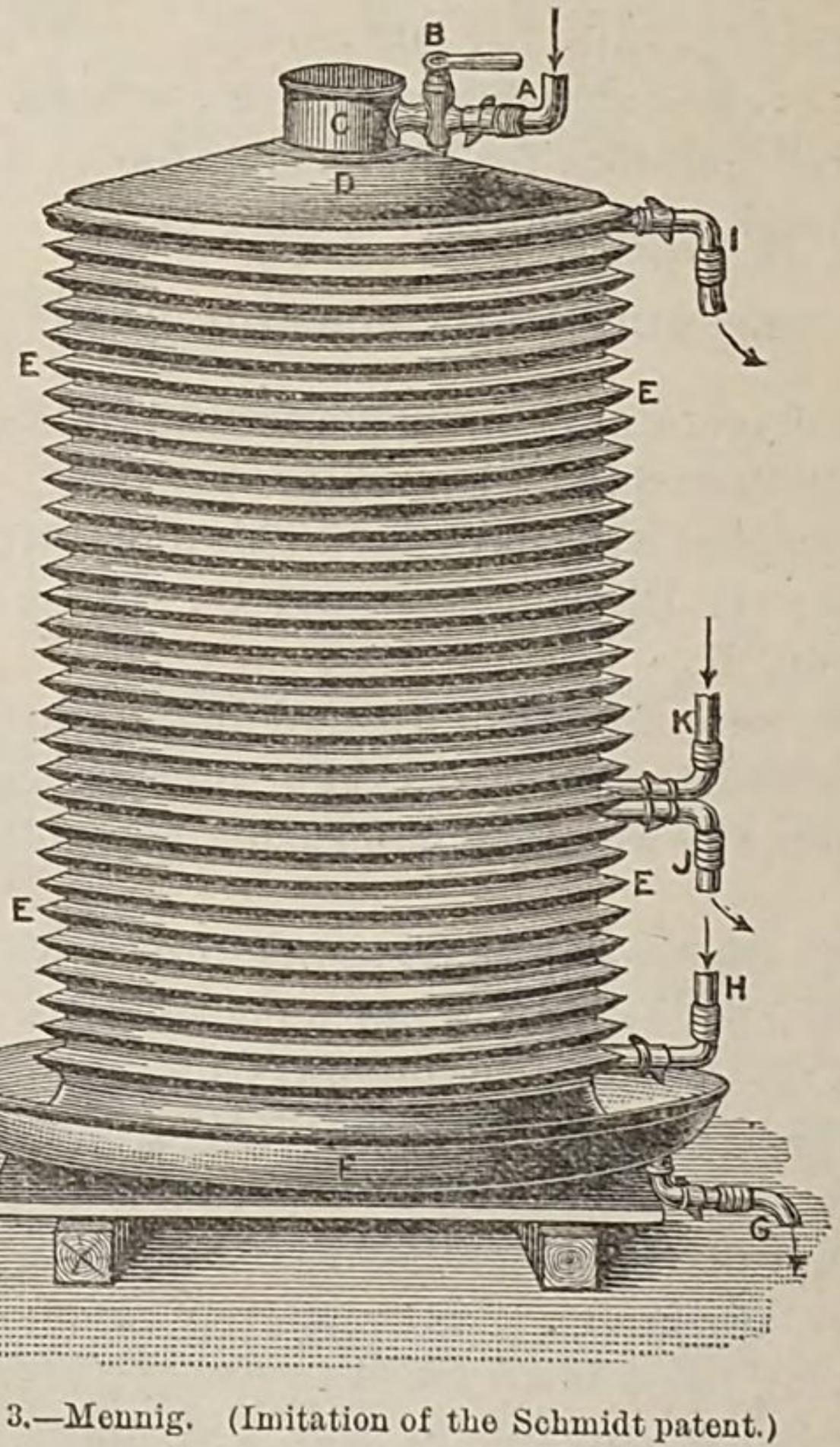
The distribution pan consists of a round disk slightly curved, supplied with a central basin which receives the regulating stopple. This basin serves to distribute the wort and can easily be removed from the apparatus.

The undulated cylinder is formed of oval pipes, which are soldered in following a curve making the form of a continued screw or spiral; the form of the pipes, as well as their adaptation, is calculated with the view of obtaining the greatest possible cooling effect, so that the surface to be gone over by the wort be as long as possible and the flowing not too rapid. By means of the receiving basin the flowing of the wort is obtained in a regular manner, thus completely avoiding foam and splashing. The receiving basin is attached to the cylinder in the apparatus Nos. 1, 2, and 3, but is movable in Nos. 4, 5, and 6, but if desired can also be fixed to the cylinder of the last-mentioned apparatus. The wort to be cooled is brought into the receiving and distributing basin B by the regulating stopple A. It penetrates into the distributing pan C by the openings in the bottom of the receiving basin; it runs from this basin in a regular manner over the cooler D, and reaches the collecting basin K cold, where, by means of stopple E it is conducted into the fermenting vats.

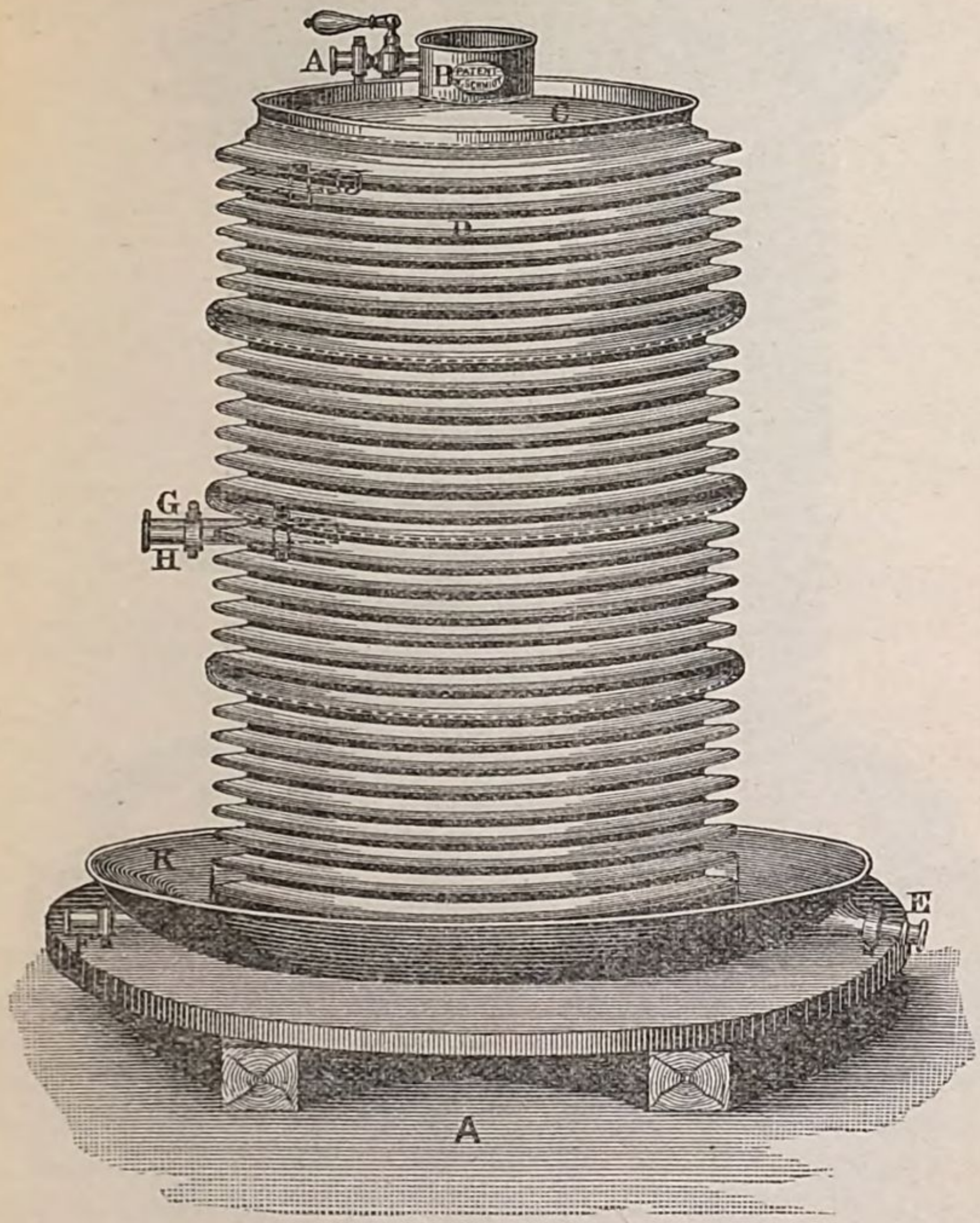
The cold water is conducted into two separate divisions. For the upper division ordinary water is used, for the lower division ice-water is employed. By means of a communication pipe the apparatus can be supplied with either ordinary or ice-water, as may be desired. The ascension of the cold water is obtained by pumps or pressure. The ice-water enters the apparatus by F and circulates through the pipes surrounding the cylinder and flows out by stopple G. Ordinary water circulates likewise in the pipes; it enters by H and flows out by J. The

apparatus reduces the temperature of the beer in an hour from one-half to 1 degree above ice-water temperature. If only ordinary water is used the temperature of the beer is reduced to that of the water.

Model B has two cooling surfaces, external and internal.

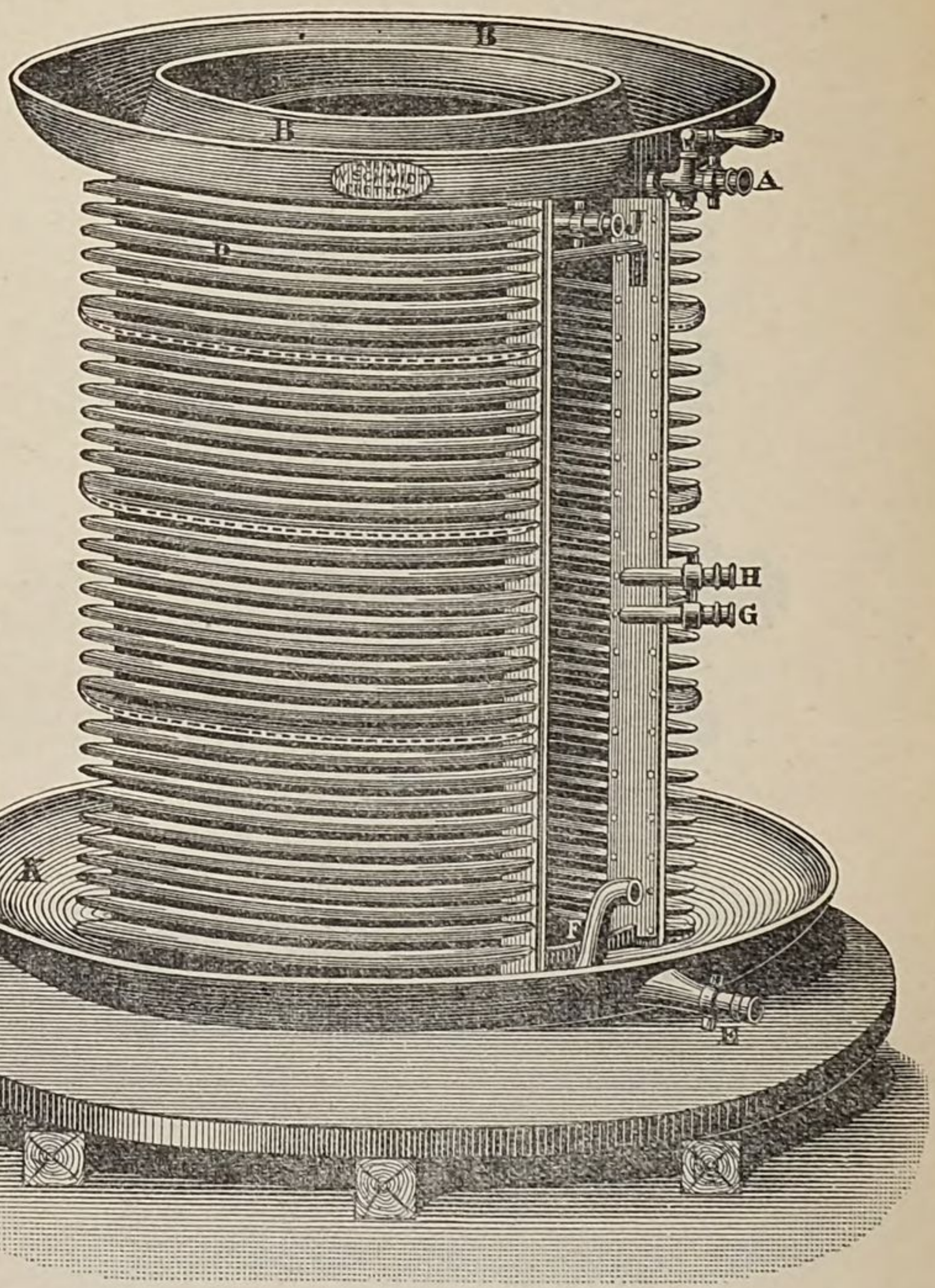


No. 3.—Mennig. (Imitation of the Schmidt patent.)



No. 5.—Model A.

A. Regulating stopple.
B. Basin of reception and distribution.
C. Pan of distribution.
D. Reeded or fluted cylinders.
E. Stopple for drawing off the wort.
F. Ice-water inlet.
G. Ice-water outlet.
H. Ordinary cold-water inlet.
J. Ordinary cold-water outlet.
K. Receiving basin of the cooled wort.



No. 6.—Model B.

A. Regulating stopple.
B. Basin of reception and distribution.
D. Reeded or fluted cylinders.
E. Stopple for drawing off the wort.
F. Ice-water inlet.
G. Ice-water outlet.
H. Ordinary cold-water inlet.
J. Ordinary cold-water outlet.
K. Receiving basin of the cooled wort.

This apparatus can cool from 50 to 120 hectoliters per hour.

PRICE AND DIMENSIONS OF MODEL A.

Number.	Full height of apparatus.	Diameter of cooling cylinder.	Number of flutings.	Extent of the cooling surface.	Cooling power per hour.	Price of apparatus.
	Meters.	*Meters.*		*Sq.meters.*	*Hectoliters.*	*Francs.*
1	1.30	.48	27	3.50	7	325.00
2	1.40	.59	28	5.00.	10	437.50
3	1.50	.75	28	7.50	15	562.50
4	1.60	.92	29	10.00	20	750.00
5	1.65	1.08	30	12.50	25	937.50
6	1.75	1.27	29	15.50	30	1,125.00
7	1.80	1.41	30	18.00	35	1,312.50
8	1.85	1.55	31	20.50	40	1,475.00

PRICE AND DIMENSIONS OF MODEL B.

9	1.67	1.44	30	33.00	50	1,750.00
10	1.77	1.59	32	39.50	60	2,075.00
11	1.87	1.74	34	46.50	70	2,425.00
12	1.87	1.92	34	52.50	80	2,775.00
13	1.97	2.04	36	59.50	90	3,125.00
14	1.97	2.22	36	65.50	100	3,475.00

GEO. W. ROOSEVELT,
Consul.

UNITED STATES CONSULATE,
Brussels, February 21, 1890.

LIEGE.

REPORT BY CONSUL PRESTON.

Refrigerators are scarcely ever used; I have never seen one here. The weather is never so warm but that the butchers hang their meat in the open air, and in private houses there is no need for them.

Very little ice is used, or is necessary here, except in the restaurants or bakeries where they make ices and ice-cream. Ice has been brought for these purposes for the last two years from Norway, via Ostend, at prices ranging from $2.90, $3.87, to $3.96 per 1,000 kilograms, in carloads of 10,000 kilograms. There are two manufactories for making artificial ice in Liege. It is now selling at $39.60 for 10,000 kilograms; $5.79 for 1,000 kilograms; $3.96 for 500 kilograms; 96.5 cents for 100 kilograms; 58 cents for 50 kilograms.

I may add that the river never freezes here, therefore all the ice used is artificial or imported.

WM. S. PRESTON,
Consul.

UNITED STATES CONSULATE,
Liege, January 14, 1890.

DENMARK.

REPORT BY CONSUL RYDER OF COPENHAGEN.

Besides the use of ice in the numerous home industries, such as breweries, dairies, slaughter-houses, etc., where the ice is preserved in underground cellars and placed in tanks constructed according to its special use for cooling of large stock rooms and milk rooms, refrigerating boxes are used here in large quantities in all the hospitals, hotels, restaurants, beer saloons, bakeries, butcher, fish, milk, and provision shops, as well as in many private establishments.

The boxes so employed, and which are almost entirely of home manufacture, are of different systems; of which the first consists of two wooden cases, the one contained within the other, the interstices between of 1½–2 inches in width being filled with cork shavings, the doors being quite tight, with one or two air valves to the inside. The interior of the boxes is cased with zinc sheathing and the shelves placed therein are of grating form. From the top plate of the box, a tank, also of zinc sheathing, to contain the ice, extends down the middle of the box or is attached to one side of the cooling-chamber, the ice being placed on a grating in the tank, the lower part of the tank receiving the escaping water. The most of the refrigerators sold here would appear to be of this pattern; but experience has shown that the system is faulty in many respects. The keeping clean of the zinc casing is attended with much trouble, and a deposit of zinc white is found to be left on the sheets; the inside wooden case is also found to be very prone to decay underneath the zinc.

The other system is also constructed of two wooden cases and the interstices are filled with cork waste, but has no inside casing of zinc. The interior of the box is on the other hand painted with a covering of thick clear lac, with which the box is easily kept clean. Furthermore, the tank containing the ice is of galvanized iron plates, the ice being likewise placed upon a grating, the escaping water however here being carried away through a pipe at the back of the box leading to an iron receiver below, the air valves on the doors or the sides of these refrigerators to be kept open when in use.

This latter system is now regarded here as the most suitable and as such is now accepted by and is in use at all the hospitals.

Both of the above-named systems of refrigerators are almost entirely supplied by home manufacturers, only a very small number of a somewhat similar construction to system No. 1 being imported from Germany, but these are considered as being very inferior in design and workmanship to those of home make and have met with no success in the trade.

The dimensions and retail prices calculated in dollars and cents for the two kinds of refrigerators are as follows:

[Outside measurements.]

	Height.	Breadth.	Depth.	Price.
	Inches.	*Inches.*	*Inches.*	
No. 1	29	26	21	$8.57
No. 2	32	31	22	13.40
No. 3	39	29	23	17.42
No. 4	51	26	23	21.44
No. 5	53	33	26	29.48
No. 6	65	31	21	26.80
No. 7	39	42	25	26.80
No. 8	44	46	26	32.16
No. 9	53	55	27	48.24
No. 10	49	45	26¾	29.48
No. 11	64	50	27	53.60
No. 12	67	25	27	24.12

Retail prices of boxes are as follows:

[Outside measurements.]

	Height.	Breadth.	Depth.	Price.
	Inches.	*Inches.*	*Inches.*	
No. 1	36	27	24	$12.06
No. 2	.....	.....	.....	13.40
No. 3	48	48	24	17.42
No. 4	41	41	24	21.44
No. 5	54	39	27	26.80
No. 6	74	34	24	32.16
No. 7	54	53	26½	32.16

In both cases a discount varying from 15 to 20 per cent. is given to wholesale dealers.

Ice is usually secured between the months of December and March, and it is kept in ice cellars, as before mentioned.

In the principal towns some companies keep large quantities of ice in stock and retail it for daily use during the summer months, the price ruling generally at about 20 cents per 100 pounds. Even in exceptionally mild winters, like the present, sufficient stocks of ice can almost always be collected during the short intervals of frost to meet all the requirements of the country, ice 3 inches thick being all that is necessary for safe preservation. In years of ice failure, which is, however, of very rare occurrence, the necessary supplies have to be made good by imports from Norway, when an enhanced price of the article will naturally be entailed.

I am not in a position to say whether the above given prices, with the concurrent charges of freight, insurance, customs dues, etc., would allow our manufacturers at home to introduce their own works with prospects of success. If so, the object would doubtless be best attained through the aid of an active and respectable commission agent on the spot, and we have now direct steam communication with the United States, which must always facilitate such enterprises.

HENRY B. RYDER,
Consul.

UNITED STATES CONSULATE,
Copenhagen, April 3, 1890.

FRANCE.

MARSEILLES.

REPORT BY CONSUL TRAIL.

Refrigerators are not used in the Marseilles consular district, in private houses. I found one at the "American Bar," which was English make, imported by the proprietor. They are not for sale in Marseilles, the inhabitants of this city not as yet being educated up to that point where they are regarded a necessity. At the Grand Hotel Louvre et Paix, the best hotel here, probably, with accommodations for one hundred and fifty guests, the method of keeping meat and fish fresh is as follows: An ice-box of stone and cement, 3 feet high, 2 feet in width, and about 7 feet in length, is built onto the wall in the kitchen. The bottom of this box is V-shaped to carry off the melted ice; above this comes the ice in pieces no larger than a man's fist; on the ice is a cloth, and above this the meat is spread. This box consumes 100 pounds of ice per diem, costing from 1 to 1¼ cents per pound, according to the season. Switzerland supplies Marseilles with nearly all the natural ice it consumes.

Butchering is done once a day in winter and twice a day in summer, and families supply themselves with meat that often. The meat is cooked only a few hours after the killing, and, as a consequence, tender meat is an unknown luxury here.

Practically no effort whatever is made to preserve foods and liquids, the dealer furnishing a fresh supply once or twice each day, and the consumer taking only the quantity that he has immediate need of, and that must be used at once.

Ice is also manufactured to some extent, there being quite a business in caraffe frappé.

These are to be found in all the cafés and restaurants.

As to the best manner of introducing refrigerators into this district, I regret to state that there are only two articles of American manufacture successfully introduced here and carried on with success in establishments devoted solely to their exhibition and sale, the Singer sewing-machine and the Waterbury watch. How these companies succeeded when so many others either failed or abandoned the idea of introducing their goods here after corresponding with the consul and securing his services in the interest of their respective enterprises, I am not informed. Business is conducted on such different principles here from what it is in the United States that, in many cases, owing to the ignorance of the peculiarities of trade here on the part of American

merchants, little more than general dissatisfaction has resulted to both the American shipper and the Marseilles consignee as the return for the consul's best efforts for extending his country's foreign trade.

Experience has proved that the better plan is for the manufacturer or exporter to come in person or by his representative. Through the consul he can then meet the merchants, and from his own observation, judgment, and business experience will be able to decide if the field is a good one for his goods and as to the manner of their introduction.

Marseilles is one of the most backward cities in all Europe, slow to take advantage of improvements, as the sanitary condition of the place proves only too well. But with perserverance and patience a good agent to sell refrigerators, speaking the language and having a knowledge of the business methods, would in a reasonable time open up an active refrigerator market here.

The city has a population of more than 375,000 inhabitants. As the summers are very long and hot and the winters generally very mild, there never being any ice formed in or near the city, some means of preserving meats and liquids would seem so necessary that the advantages of refrigerators once explained their use would soon follow as a necessary consequence.

I will be most happy to do anything in my power to assist the manufacturers in extending their trade to this quarter of the globe.

C. B. TRAIL,
Consul.

UNITED STATES CONSULATE,
Marseilles, February 5, 1890.

LIMOGES.

REPORT BY COMMERCIAL AGENT GRIFFIN.

This subject is one that has never before been considered in this section, and the little information that answers the questions has been obtained with difficulty.

Refrigerators are almost entirely unknown throughout this section of France. The only methods employed to preserve meat, milk, etc., are placing them in cellars, wells, or cool places. As a household article the refrigerator needs to be brought to the notice of the people, and after careful conversation with many, it is thought that such an article might be introduced, the chief difficulty being the lack of ice.

It would be advisable to have the smaller sizes introduced here, as the apartments are usually quite small and room must be economized in the average household. The construction should be such as to require little or no ice; could chemicals be employed in the place of ice it would be a great advantage in introducing the refrigerator.

The sizes that could be possibly introduced are the smaller ones and so constructed as to take the place of a closet or buffet; with a place specially adapted to keep the wine cool, the arrangement should be such that the bottles can lie upon the side. The price should be moderate; but there might some be introduced of fancy wood and ornamental form that would suit the dining-room better than the kitchen or cellar, as the kitchen is always small.

Ice is manufactured, and is very scarce and very dear. I know of no families who employ it as a household article; it is used in the markets to preserve fish, and among a few pâtissiers who make ice-cream, and a few of the better restaurants. The price is from $1 to $3 per 100 pounds.

The best way to introduce refrigerators in this district would be to show their practicability in the markets where there is a great loss occasioned by the spoiling of meats and vegetables, and where it would be easy to demonstrate their utility. I would strongly recommend that only Americans be intrusted with the work of introducing these goods, for it too often happens that superior articles of American manufacture are superseded by inferior foreign goods, simply because of a lack of proper American representation in placing them upon the market.

WALTER T. GRIFFIN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Limoges, January 16, 1890.

BORDEAUX.

REPORT BY CONSUL KNOWLES.

Refrigerators are comparatively unknown in this part of France, and yet there is perhaps no part of Europe where they could be used to greater advantage. Bordeaux has the reputation of being the "best fed city" in the world, and judging from what I have already seen and tasted I am of the opinion that its fame in this respect is not undeserved.

I find in the mind of many Bordeaux people a doubt or question as to the advantage and general utility of refrigerators. By many is held the idea that the present excellence of all our markets would be decreased by the introduction and use of refrigerators.

The few refrigerators I have been able to find in this city are seemingly very imperfect and open to many great objections. They are badly constructed and are really nothing more than a crude kind of ice-box. Take a large box and line it with zinc and you will have what goes for a refrigerator here. Of the five or six I examined, only one was provided with a lid or cover. The dimensions are about 7 feet long, 3½ feet wide by 3 feet in depth. There is no separate compartment for the ice, and

this defective arrangement is evidently the cause of the meats placed in the boxes becoming wet and soggy, a condition that annoys the butcher and which is the principal objection on the part of the marketmen to the system of artificial preservation of meats.

From the appearance of the boxes I should say they are "home-made," yet I have been informed that they are manufactured and sold by a firm in Paris, which has, so far as I can learn, the monopoly of manufacturing refrigerators (?) for the European trade.

There are several artificial ice manufactories in this city, and excepting the small amount of natural ice imported from Norway, the demand is supplied by them. The average price of ice in this city is about 75 cents per 100 pounds.

I am convinced that the non-use of refrigerators in this district is due more to a lack of acquaintance with the system of artificial preservation than to any existing prejudice against it. I am positive that the general use of the American refrigerators in this city would result in economizing living expenses and would ultimately reduce the price of food products. This happy advantage and benefit need only to be demonstrated, for then it would at once surmount any and all objections urged against the system, and the refrigerator that refrigerates would speedily become not only a necessity but a blessing to every home.

There is but one successful way to introduce the American refrigerators here, and that is to place a few of them with some of our reliable people, and let them be thoroughly tried and tested. If they are productive of good results the indorsements and testimonials would give them a recommendation and standing in the market here that they would not otherwise have and without which it would be very difficult if not impossible to sell at a profit. The French will not buy a new thing before they try it. They demand first a trial and if it proves satisfactory the article is purchased, but this, however, is a condition of purchase the fairness of which too few American firms recognize.

HORACE G. KNOWLES,
Consul.

UNITED STATES CONSULATE,
Bordeaux, March 6, 1890.

LYONS.

REPORT BY CONSUL FAIRFIELD.

Refrigerators are used somewhat, but by no means as extensively as in the Northern States of our own country. As far as I have been able to find out, their use here is almost entirely confined to those keeping restaurants and to butchers.

It is the general habit of the people here to buy only what they want for the day, and at night nothing remains to be kept over.

It has seemed to me, however, that if the conveniences of a first-class refrigerator were better understood they would be much more in demand, especially if they could be furnished at a lower price than that at which they are now sold.

My impression is that it would soon be as it is now with American base-burners, which this winter are for sale everywhere, so thoroughly have they proved themselves to be a convenience and an economy.

There are no peculiar features required in the construction of refrigerators for this district. Judging from my six months' experience in housekeeping here, I think that the refrigerator which we used in our Michigan home would meet our needs as fully here as there.

The refrigerators in use in this district are manufactured in Lyons; but yet I presume that they are probably made in two or three other of the larger towns. There are three establishments in this city where they are made, but in no large quantity. They are not kept in stock, as with us in America, but each one is made to order.

The sizes are various, and somewhat irregular, each, as before stated, being made to order. The formation is decidedly inferior to those that are made with us, and less convenient in arrangement. The prices are much higher, growing out of the fact, I think, that those who make them make but few, comparatively. The establishment in this city which does the largest business sells less than one hundred a year. A small refrigerator, about a yard wide, 40 inches high, and 20 inches deep, sells at $14. I found one 8 feet high, 7 feet wide, 2½ feet deep, for which the purchaser paid $75.

Some of the ice is manufactured artificially, but more of it is brought from the Jura Mountains. It sells in Lyons at 37½ cents per 100 pounds, or 80 cents 100 kilograms.

I am also requested to report upon the best manner of introducing the American refrigerators into this district.

This is a mere matter of "business judgment."

At present refrigerators are not kept in stock by any class of merchants or manufacturers.

I think if a few dozen refrigerators of assorted sizes were put into the hands of some of the more enterprising merchants, who would have them on hand, advertise them, and exhibit them, in the same way in which American base-burners have been brought to the attention of the people of this city, that they would soon come to be regarded as a necessary article of furniture, that no well-regulated family could do without. It would not then be a necessity, as it is now, that a housekeeper should buy simply for the day.

ED'D B. FAIRFIELD,
Consul.

UNITED STATES CONSULATE,
Lyons, February 25, 1890.

NICE.

REPORT BY CONSUL BRADLEY.

Referring to circular of November 25, regarding use and introduction of refrigerators in my district I beg to offer the following answers to the questions:

Very few used. None for sale.

No peculiar features required.

Manufactured by the carpenters.

Ice is brought from the mountains near Nice and sells for 5 cents per kilo ($2\frac{1}{5}$ pounds).

The resident population are very conservative—not inclined to adopt new ideas which must be paid for.

They use no iced drinks. During the winter food which is bought in small quantities is readily preserved without ice. In summer perishable food is distributed several times each day. Meat enough for the day is butchered in the morning of each day.

A number of moderate-priced refrigerators placed where they could be seen in operation would be the best means of introducing them to the people.

WM. HARRISON BRADLEY,
Consul.

UNITED STATES CONSULATE,
Nice, January 7, 1890.

NORMANDY.

REPORT BY CONSUL WILLIAMS OF ROUEN.

The request for information on the subject of refrigerators arrived at a very inopportune moment. The influenza which generally pervaded this region left its victims in no humor to discuss the merits of refrigerators, for which articles they have very little interest, as they have existed for ages without them and seem inclined to spend their money for some more ornamental piece of furniture. The climate, mode of living, and habits of the Normans do not incline them to the use of ice.

The heat is not intense, and a cellar for storage of wine or cider is attached to every domicile. The fresh sea breezes of the northern and western coast render ice useless in these ports.

The people are accustomed to buy their supplies for daily use, and their purchases of fish, flesh, fowls, and vegetables and fruits are gauged so closely to their daily necessities that a refrigerator would be considered an incumbrance in their small apartments. They consider ice as detrimental to their beverages, of which water usually forms a small constituent.

Ice is used principally at the sea-ports of this consulate for packing fresh fish for transportation to Paris and other inland cities, and breweries and distillers, who, however, resort to other means for cooling. They use a number of refrigerating machines which are manufactured by Lawrence & Co. at London and at Lille and resemble very closely the De La Vergne manufactured at New York. Replying to the interrogatories:

In Boulogne-sur-Mer there are few, if any, in use. The same may be said to apply to Lille, Dunkirk, Roubaix, Dieppe, and Amiens. At one restaurant at Rouen a refrigerator was formed in the construction of the building; the most diligent research could not unearth another.

In the city of Calais only two were discoverable, one at the lunch counter of the railway station (seldom employed), the other in possession of the consular agent of the United States at his country residence, used for preserving meat and fish.

Refrigerators adapted to the use of restaurants and country residences would be most apt to meet with sales and must be of the cheapest order.

Both of those at Calais were manufactured by Kent, the English manufacturer.

ICE.

It is brought chiefly from Sweden and Norway. At Rouen the quantity imported varies from 900 to 1,200 tons; price per 100 pounds varies from 5 francs to 10 francs, according to season and quantity. At Dunkirk it costs about 40 francs per 1,000 kilograms (a gross ton) and sells at 4 francs to 6 francs per hundred-weight. At Dieppe in 1888, 189 tons were brought from Norway. In 1889, 1,838 tons were imported, all used for packing fish. At Boulogne-sur-Mer an ice-factory can produce more than enough to supply the wants of the population; there were imported, however, 634,800 pounds of ice in 1889, some of which was forwarded to other destinations and the rest used in preserving fresh fish to supply the markets of Paris and other inland towns. Very little ice is sold by the small quantity, but generally by the ton at from 25 francs to 30 francs for both the manufactured and imported.

Ice-dealers in the cities of Lille, Amiens, Boulogne-sur-Mer, Roubaix, Rouen, and other large towns would be more apt and better fitted to urge sales of refrigerators. The ice-dealer and the leading confectioner of this city state that they believe fifty refrigerators could be placed at Rouen, and if supplied with circulars and price-lists I would place them in the hands of such persons, believing thereby that I could best carry out the desire of the Department to assist the manufacturers of refrigerators in their efforts to effect sales in this consular district.

CHARLES P. WILLIAMS,
Consul.

UNITED STATES CONSULATE,
Rouen, March 10, 1890.

PARIS.

REPORT BY CONSUL-GENERAL RATHBONE.

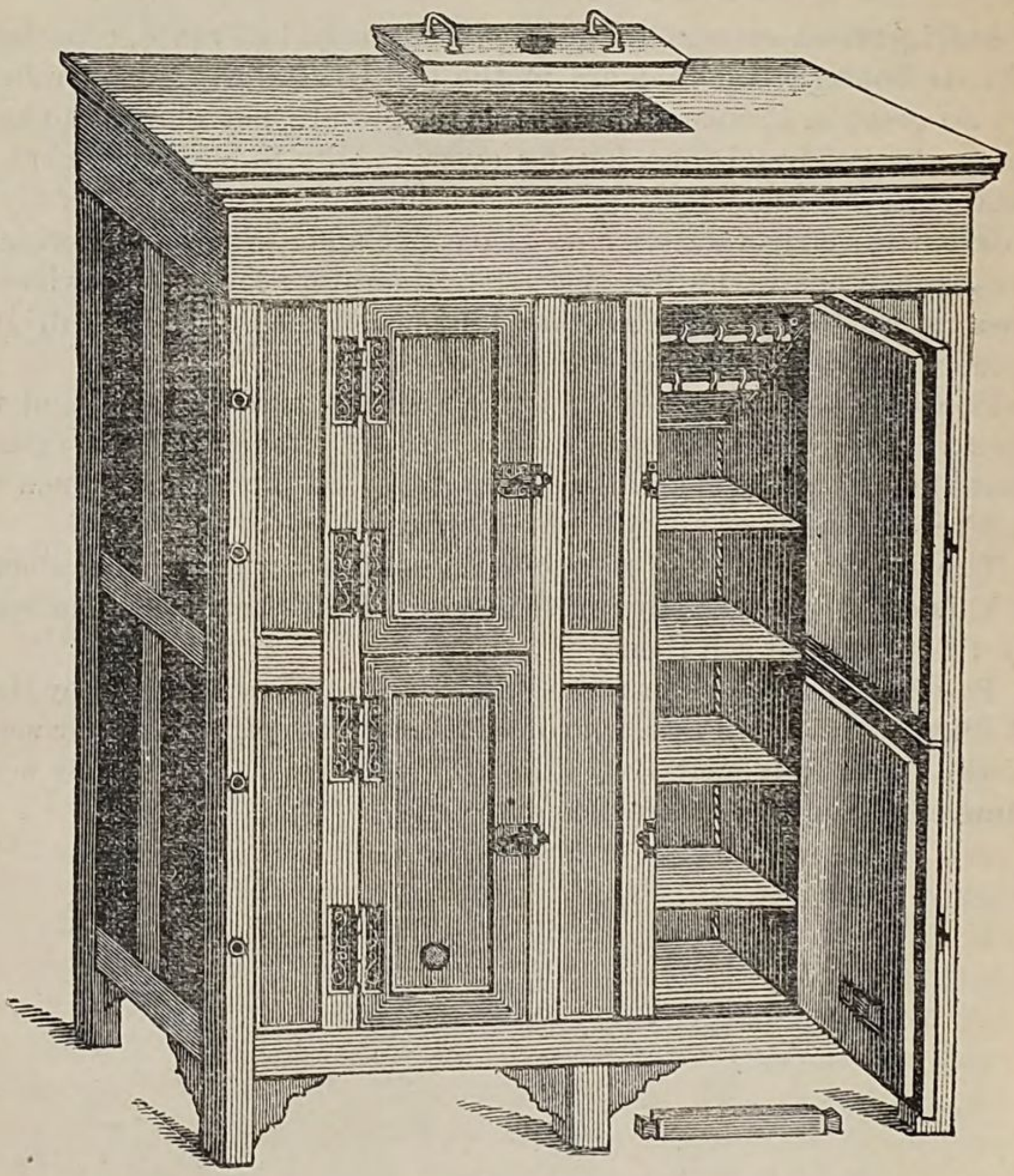
Refrigerators are much less extensively used in France, especially in private houses, than they are in the United States. Summer heat is not so great in France, and French people are not obliged to keep a large store of provisions, having every facility to buy them when necessary, at any time, from provision dealers. These are generally provided with refrigerators, as are also coffee and eating houses, which are very numerous in Paris. Special refrigerators for cooling wines and liquors are, to a large extent, used in most of the Paris public drinking-houses, which number about 30,000.

The only difference between refrigerators used in Paris and those used in the United States is that some have a receptacle for water and that their dimensions are generally smaller, as there is not much room in French houses or apartments to locate them.

The greater number of refrigerators used in France are manufactured in this country, especially in Paris, and most of them are manufactured by the firms that sell them.

The following drawings represent refrigerators constructed by Messrs. Williams & Co., of Paris, who obtained the first prize on their account at the Paris Universal Exhibitions of 1878 and 1882. Their several dimensions and prices are also given :

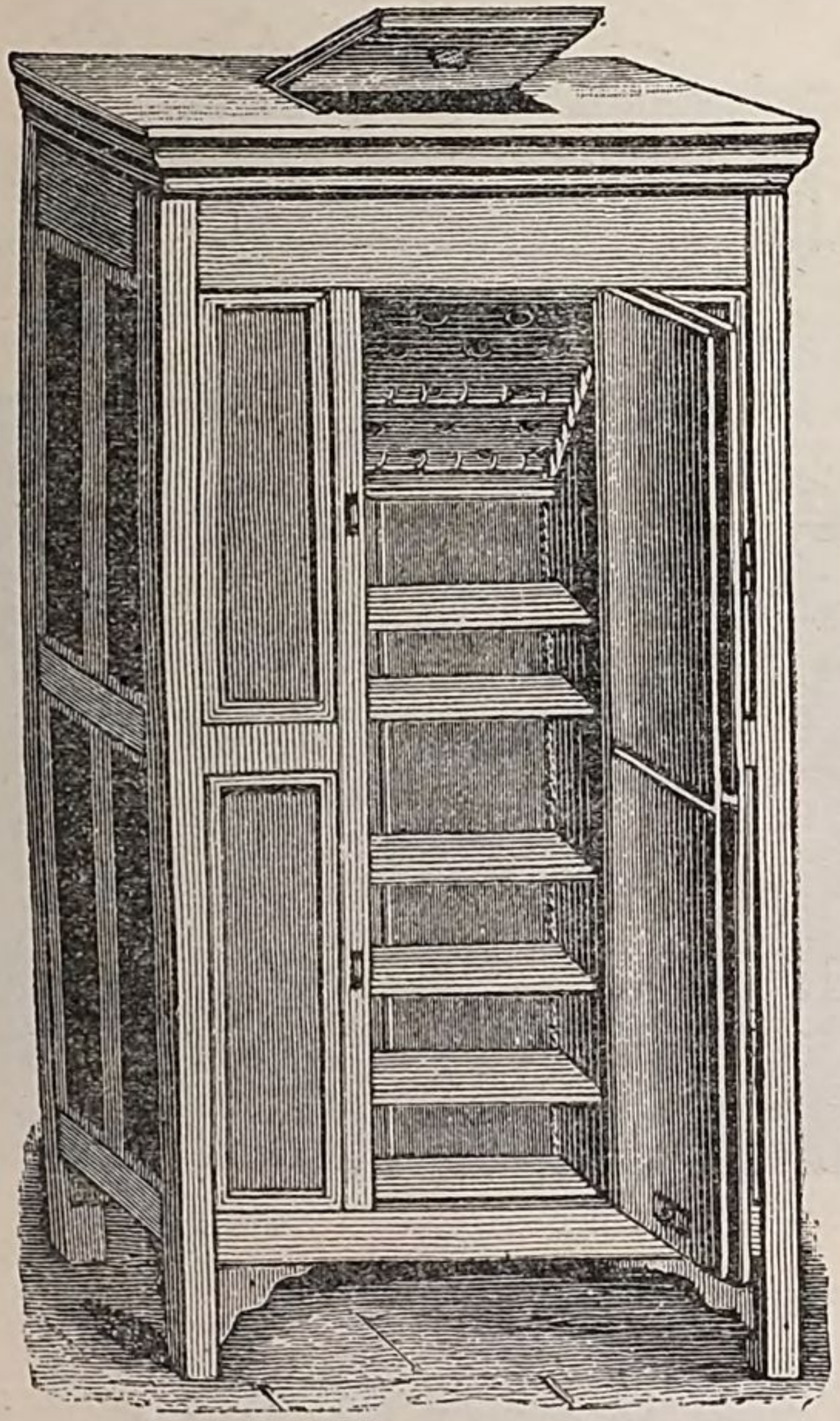
No. 1.—Refrigerators of Large Dimensions for the use of Hotels, Restaurants, Butchers Poulterers, etc.



Exterior dimensions.				
Height.	Width.	Depth.	No. of doors.	Prices.
Inches.	*Inches.*	*Inches.*		
82.7	49.2	27.6	2	$91.68
84.6	59.0	27.6	4	115.80
88.6	78.7	27.6	4	154.40

Thickness of sides, 3.9 inches.

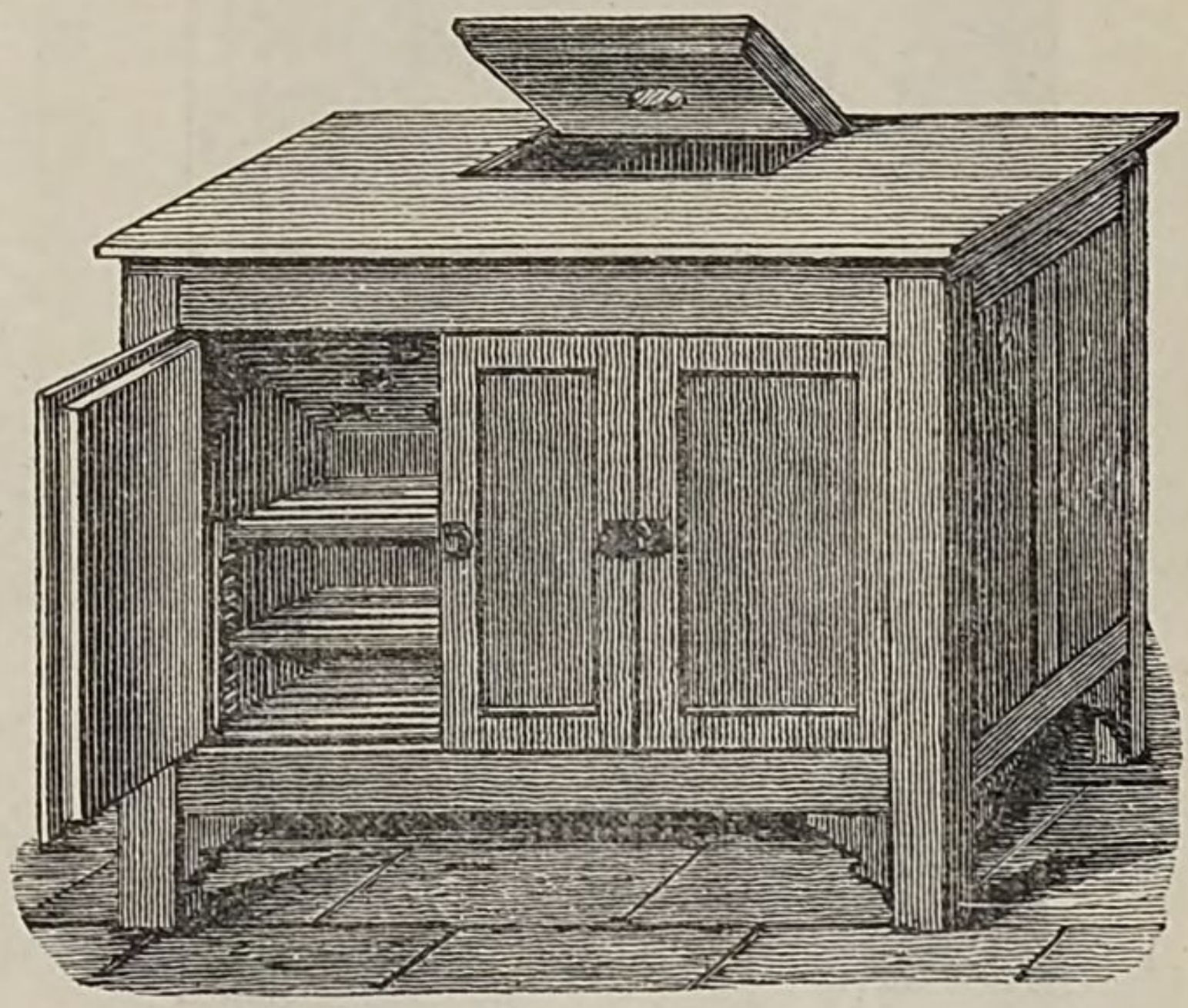
No. 2.—Refrigerators of Ordinary Dimensions for Hotels, Restaurants, Butchers, Poulterers, Private Houses, etc.



Height.	Width.	Depth.	Prices.
Inches.	*Inches.*	*Inches.*	
88.6	39.4	29.5	$77.20
78.7	39.4	24.0	67.55
76.8	30.3	24.0	53.08
59.0	27.6	21.7	42.46

Thickness of sides, 3 inches.

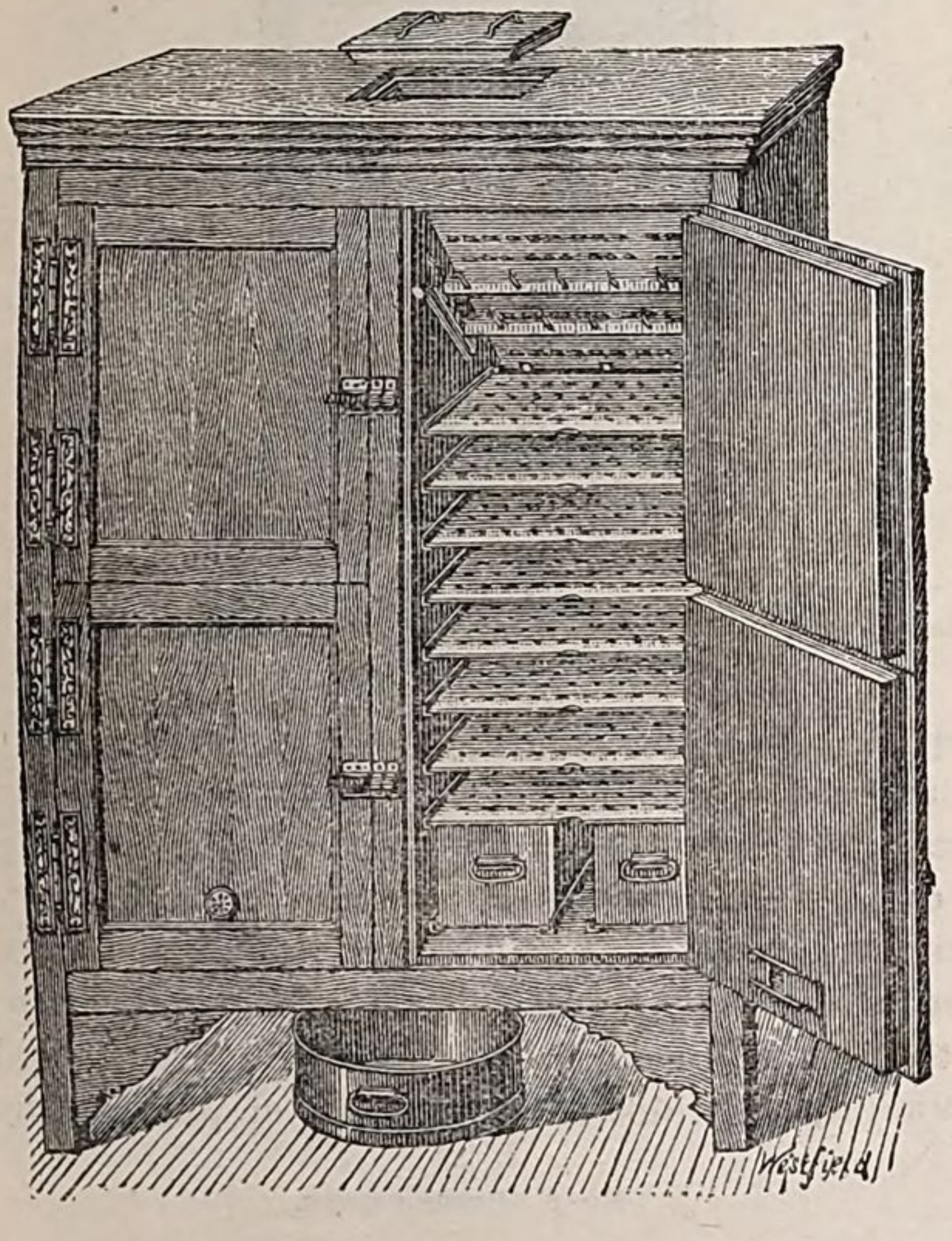
No. 3.—Refrigerators specially used by Pork Butchers and Poulterers.



Height.	Width.	Depth.	Prices.
Inches.	*Inches.*	*Inches.*	
37.4	39.4	25.6	$46.32
39.4	49.2	27.6	53.08

Thickness of sides, 3 inches.

No. 4.—Refrigerators for the Special use of Pastry Cooks.



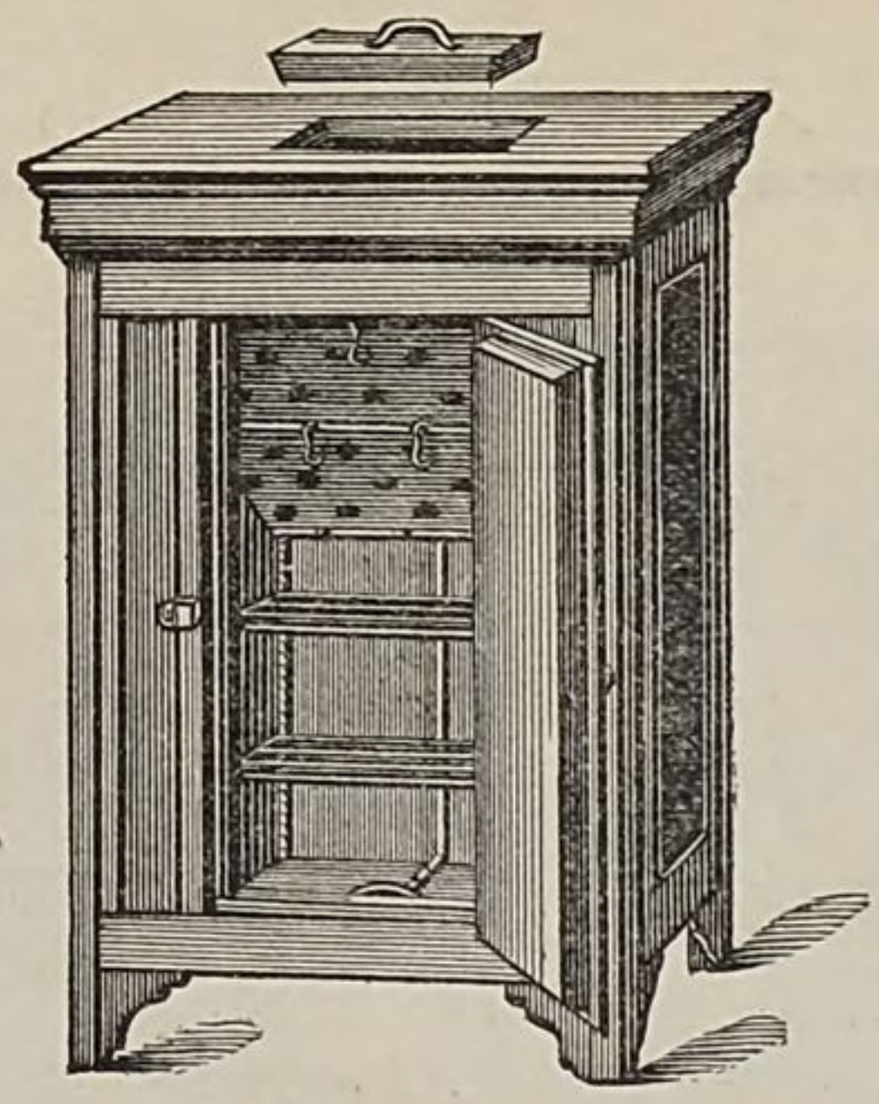
[Model with four doors and two distinct compartments.]

Description.	Height.	Width.	Depth.	Price.
	Inches.	*Inches.*	*Inches.*	
Decorated pine wood	70.9	43.8	23.6	$111.00
Varnished oak	70.9	43.8	23.6	125.45

[Model with two doors.]

Description.	Height.	Width.	Depth.	Price.
	Inches.	*Inches.*	*Inches.*	
Decorated pine wood	70.9	25.6	23.6	$57.90
Painted oak	70.9	25.6	23.6	67.55

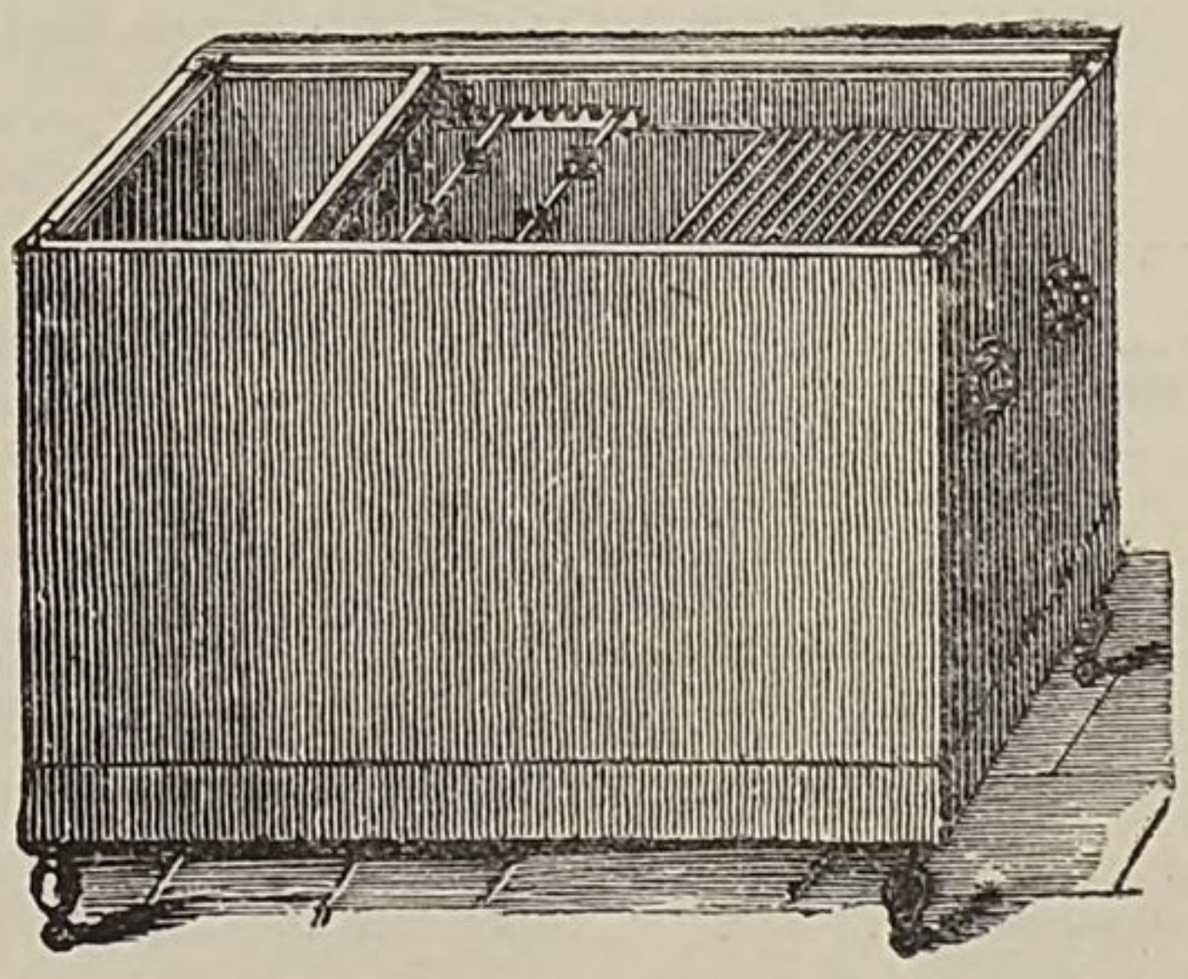
No. 5.—Refrigerators for the use of Families.



Height, 39.4 inches; width, 23.6 inches; depth, 18.5 inches; thickness of sides, 23.6 inches; price, $26.

At the top of these above-mentioned refrigerators there is an opening under which ice is suspended in a basket. The air passing through meets the ice, and becoming much cooler and more dense goes down to the bottom of the refrigerator and escapes through an under opening, bringing out the exhalations and gases produced by the provisions stored in the interior. The warm air which penetrates into the refrigerator when the doors are open has its humidity condensed by the ice, and that humidity runs down with the water produced by the melted ice.

No. 6.—Refrigerator.

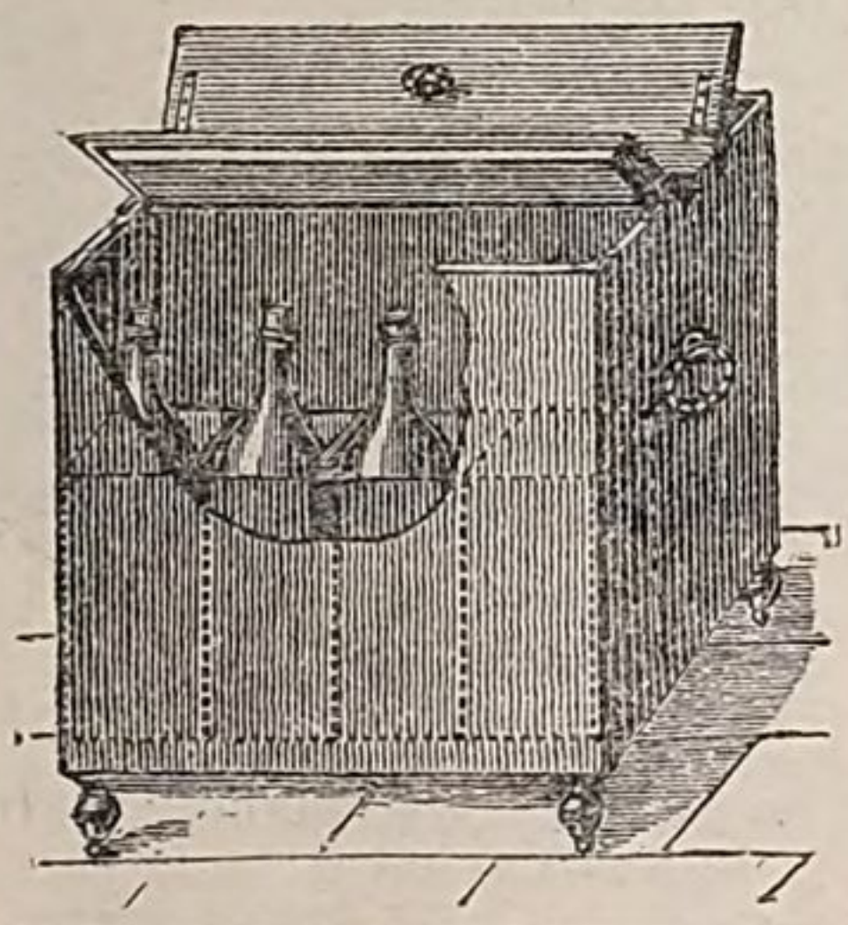


[New model.]

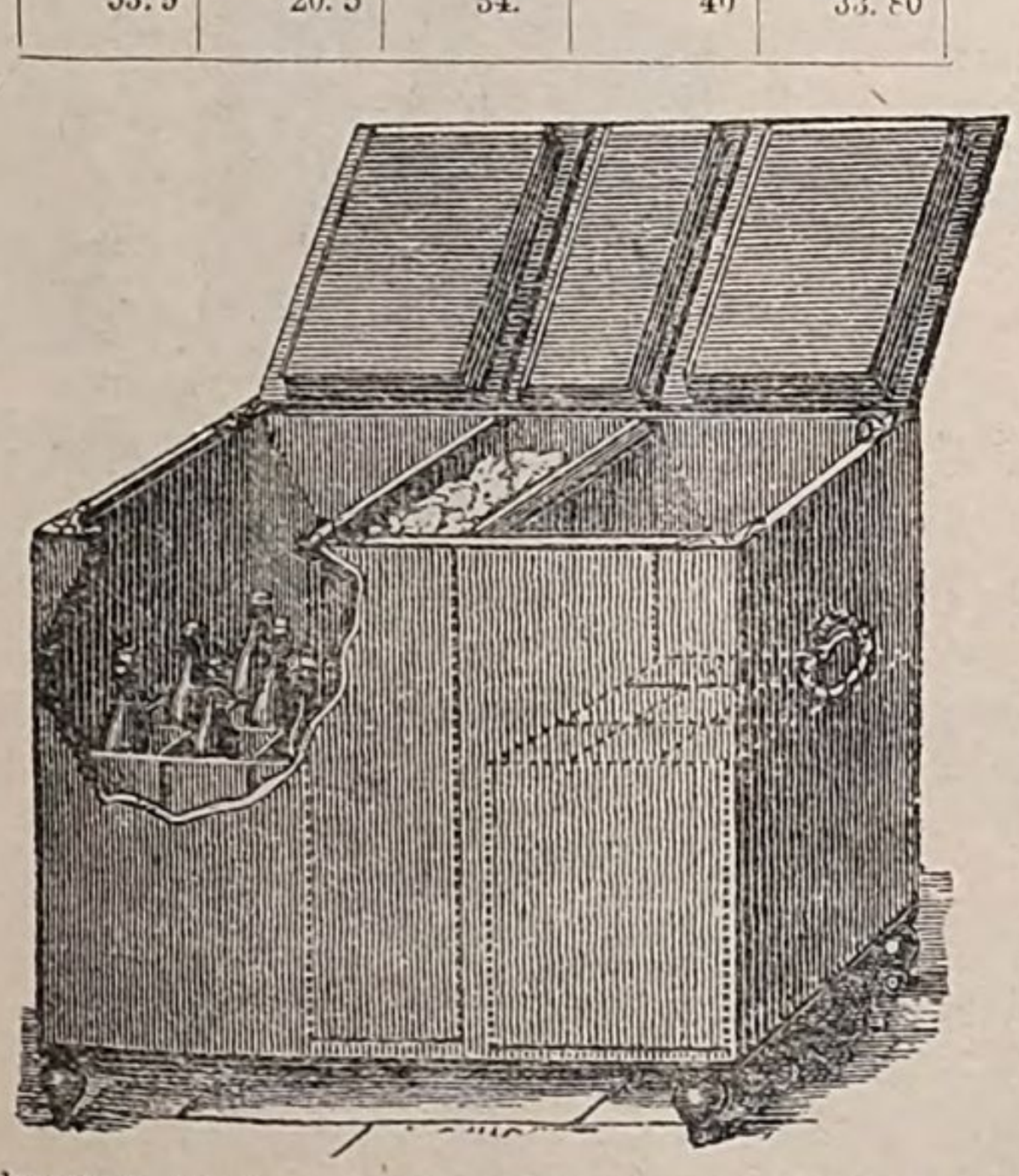
	Width.	Depth.	Height.	Price.
	Inches.	*Inches.*	*Inches.*	
No. 1	21.7	19.7	26.4	$14.50
No. 2	27.6	21.8	27.2	19.30
No. 3	33.5	22.0	28.0	24.10
No. 4	39.4	22.8	28.7	28.95
No. 5	45.3	24.0	29.5	33.80
No. 6	51.2	25.2	30.3	38.60

These refrigerators contain a support furnished with hooks to hang up provisions. In the Models Nos. 1 and 2 there are two movable gratings, and three, four, five, or six of them in Nos. 3, 4, 5, and 6.

NOS. 7 AND 8.—REFRIGERATORS FOR LIQUIDS.

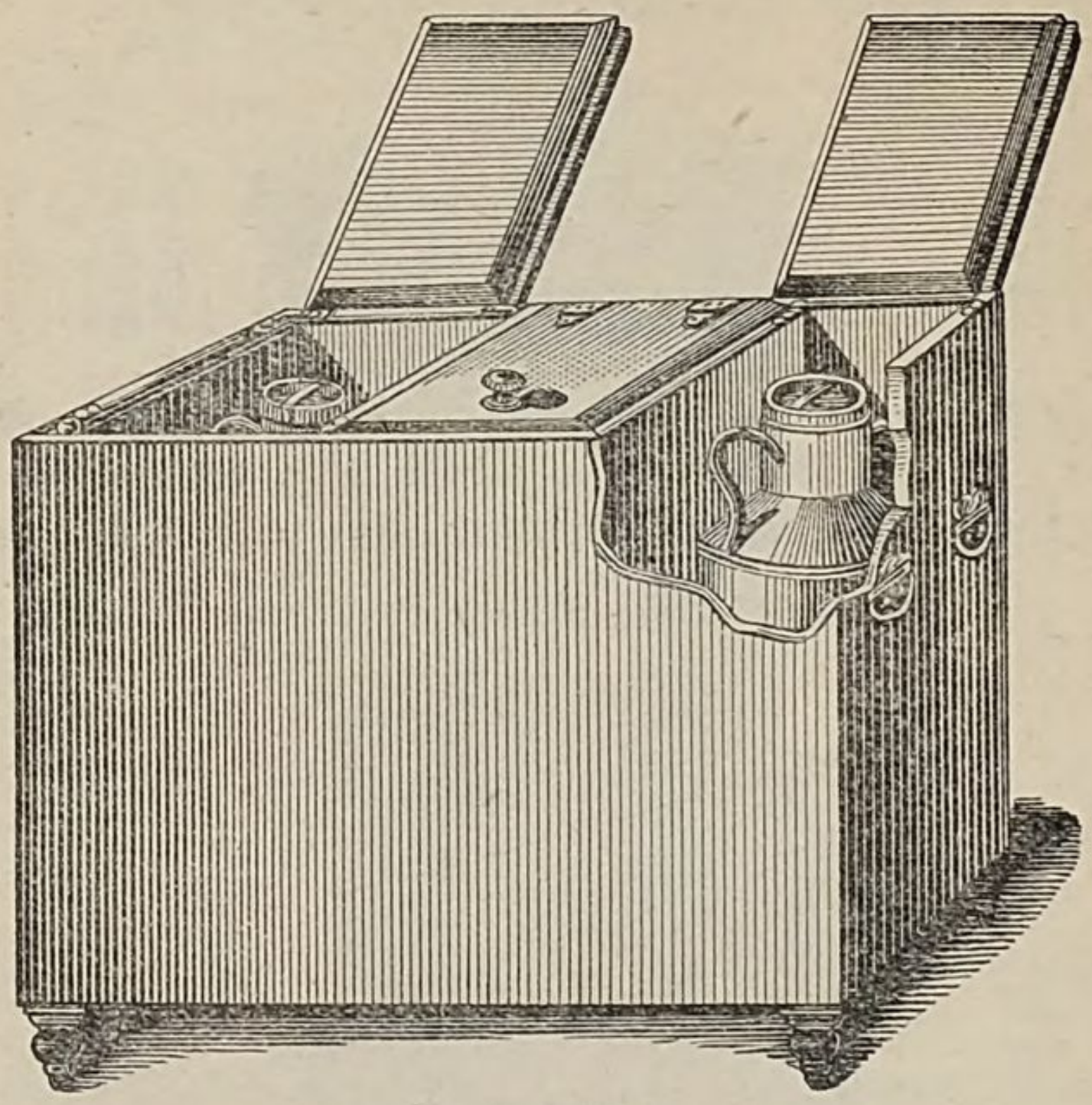


Length.	Width.	Height.	Capacity.	Price.
Inches.	*Inches.*	*Inches.*	*Bottles.*	
27.6	20.5	34.6	16	$19.30
30.7	16 5	34.6	18	23.15
47.2	16.5	34.6	21	29.00
53.9	20.5	34.	40	33.80



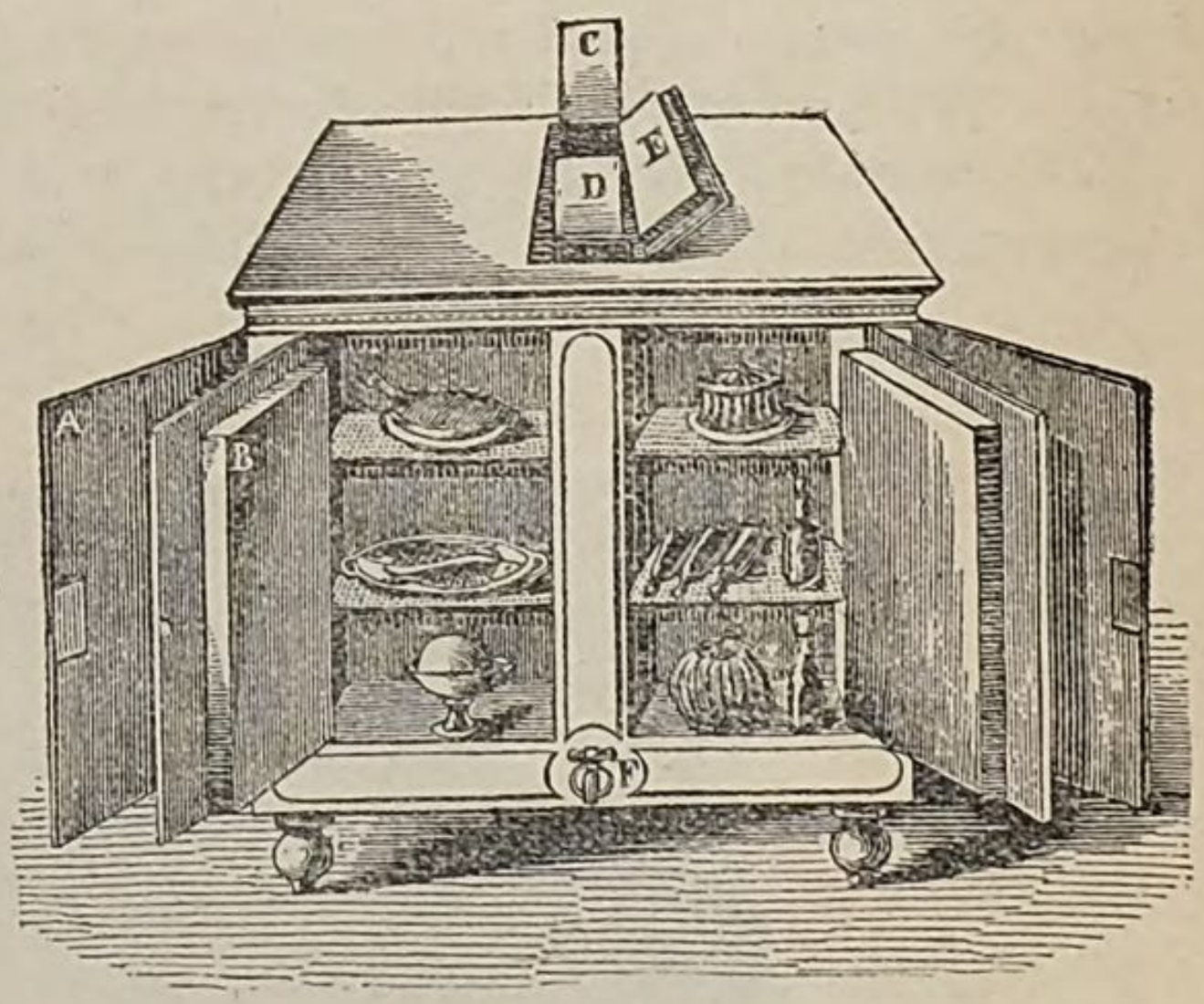
Height, 34.6 inches; length, 21.9 inches; width, 21.9 inches; price, $19.30. The ice is placed in the middle compartment.

No. 9.—Refrigerator for Milk and Cream.



Price, $34.75.

No. 10.—Refrigerator for Cafés, Restaurants, and Dining Rooms.

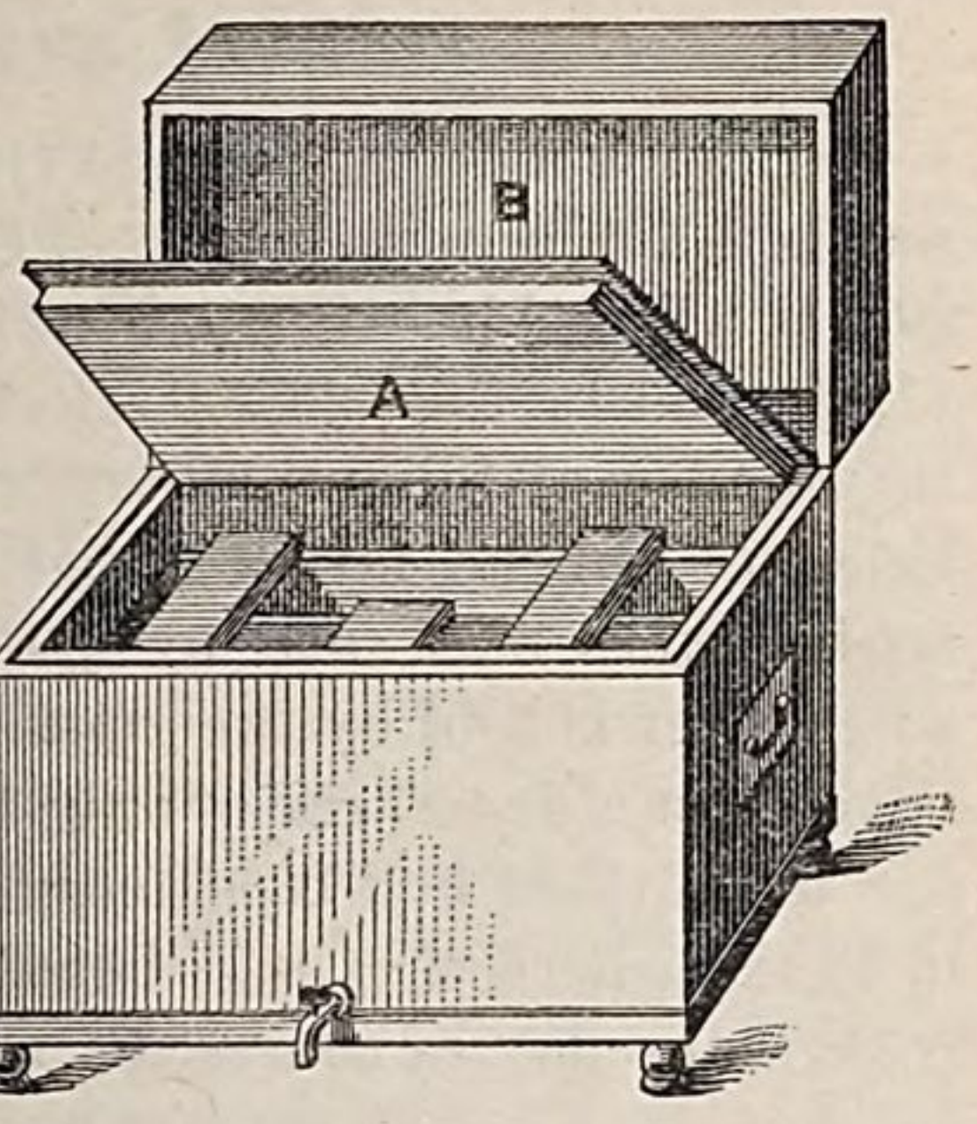


A. Exterior door.
B. Interior door.
C. Opening for the water.
D. Opening for the ice.
E. Marble cover.
F. Cock for the drawing of fresh water.

Depth, 39.4 inches; width, 20.1 inches; height, 37.8 inches; price, $72.40. (The top of the refrigerator is made of white marble.)

No. 11.—Refrigerator for Restaurants, Cafés, Hotels, Pastry Cooks, and Confectioners, Butchers, and Poulterers.

Number.	Length.	Price.
	Inches.	
No. 0	17.7	$13.50
No. 1	23.6	21.23
No. 2	27.6	25.10
No. 3	31.5	28.95
No. 4	35.4	33.78
No. 5	39.4	40.63
No. 6	43.3	50.20



These refrigerators are made like ordinary ice-boxes, lined inside with zinc, with a space of about 2½ inches between the wood and the lining, which is filled with a preparation of coke and sawdust; the ice is plac d on the bottom and on the shelves above.

There are three kinds of ice used in France: First. Natural ice, secured when possible in winter time from lakes and rivers. This ice is from 4 to 6 inches thick, and sells for 65 cents per 100 pounds. Second. Mountain ice, from Switzerland. This ice is very pure and clear and from 10 to 20 inches thick, and sells for 75 cents per 100 pounds. Third. Artificial ice, which is the most in use in France, and is made from filtered water congelated by mechanical process into blocks 6 to 10 inches thick and 4 to 5 feet in length; it is a very good ice, but does not last so long as the natural ice. The price is about 45 cents per 100 pounds.

As to the best manner of introducing refrigerators in my district, I should suggest that catalogues and price lists be sent to the following firms: Messrs. Plassard, Morin, Fillot & Cie. (Bon Marché), Rue du Bal; Messr. Directeur des Magasins du Louvre, Rue de Rivoli; Messrs. Jaluzot & Cie. (Au Printemps), Boulevard Haussman; Messrs. Druge (ménagère), 20 Boulevard Bonne Nouvelle; Messrs. Venière frères (special furnishers for drinking-houses), 2 Boulevard Richard Lenoir.

The duty on refrigerators is $1.22 per 100 pounds.

J. L. Rathbone,
Consul-General.

United States Consulate-General,
Paris, February 12, 1890.

ST. ETIENNE.

REPORT BY COMMERCIAL AGENT MALMROS.

In the town of St. Etienne (140,000 inhabitants) about one hundred refrigerators are used. From inquiries made in the towns of Roanne, 20,000, Grenoble, 45,000, Firminy, 15,000, Montbrison, 6,000, Millau, 14,000, and Le Puy, 20,000 inhabitants, the proportion of refrigerators to the number of inhabitants in each town is almost the same as in St. Etienne. In the farming districts more are used. Nearly all of the refrigerators used are by butchers, hotels, restaurants, and places where beer is sold by the glass. In St. Etienne, after much research, I have been able to hear of only four private families using refrigerators, and all of these had repeatedly and for longer periods of time sojourned in Paris, where they had become accustomed to the use of them. Refrigerators may, of course, be found in one or two families unknown to me, but I do not believe this to be the case. With the exception of thirteen, all the refrigerators used here in St. Etienne are common wooden ice-boxes, with double walls filled with sawdust, occasionally zinc lined with a hole in the bottom to let the melted ice run off. These boxes are made either by men servants employed in the houes or by carpenters. The thirteen refrigerators before mentioned as exceptions are patented by the French Government and manufactured and bought in Lyons. The most expensive of these thirteen is about $8\frac{1}{2}$ feet high, 6 feet wide, and 4 feet deep, made of hard wood and the four walls lined inside with white marble slabs. In the center it has a hollow vertical partition wall, zinc lined, which at a point about two-thirds of its height is furnished on each side with six venetian blind-like slits. The top of this refrigerator can be raised and the partition wall is filled with ice from above. The front wall is divided lengthwise into halves, each of which hangs on hinges and serve as doors. The space on each side of the partition wall is again divided once by a horizontal wall. The upper compartments so produced are closed only by the two general outside doors while the two lower compartments are each, besides, provided with a separate thick inside door. This refrigerator costs 550 francs and gives satisfaction to its owner. The other twelve refrigerators are made by another manufacturer and under another patent, but none of these twelve are constructed under a different plan from the other eleven, and vary but little even as to size.

The ordinary size of these refrigerators is 7 feet high, 4 feet wide, and 26 inches deep. They are made of wood, zinc lined, and the interior constitutes but one compartment, furnished with movable shelves, and hooks on the upper portion of the walls to hang meat upon. The ice chamber, about a foot high, is immediately under the top lid, the latter constituting the upper covering of this chamber, which is drained by a zinc pipe, of about one-half inch in diameter, running down one of the in-

side walls of the refrigerator. These refrigerators are considered by those who use them as considerably superior to the one first described. The size mentioned is sold at 400 francs; smaller sizes are sold at 350 francs. None of the thirteen refrigerators are used by others than butchers. No refrigerators are manufactured within the limits of this consular district except the common home-made ice-boxes before referred to.

So far as is apparent from the foregoing statement, there is hardly any market in this district for refrigerators. Whether a market for them may be created depends to the greater extent upon the circumstance whether private families can be induced to use them. Hitherto these have been quite content with the comparative coolness of their cellars for the preservation of their food. It must be remembered also that the French people are a very conservative one in regard to their habits, and especially in regard to everything concerning their food. Notwithstanding this, however, as the advantages of having refrigerators are great, and as they are already much used in Paris, the example of which city the provinces are greatly inclined to follow, I believe that a considerable demand for them may be developed. But this will require much time and work, and the growth of the trade will at best not be rapid unless refrigerators can be placed in the market at prices lower than the current ones. The best way to introduce the article will be to expose it for sale in the principal towns of the district, which at present is not done by any firm; to advertise in the local newspapers, and to intrust the sale to persons who will take an active interest in pushing its sale.

No peculiar features are likely to be required in the construction of refrigerators for this district.

Full price lists will no doubt be forwarded by consuls in France in whose districts refrigerators are manufactured. In case the Department should desire it I can, however, procure them.

Ice is secured by farmers, who overflow their meadows in winter with water from the springs and brooks in which this region abounds. The ice is cut when from 4 to 5 inches thick and from four to five times during the season. The farmers sell ice delivered at St. Etienne at an average price of 5 cents per 100 pounds.

OSCAR MALMROS,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
St. Etienne, February 18, 1890.

GERMANY.

AIX-LA-CHAPELLE.

REPORT BY CONSUL PARSONS.

Refrigerators are used in this consular district by keepers of hotels and restaurants, by butchers and fish merchants, by vegetable and fruit dealers, and others who handle perishable goods; also in private families of the wealthier classes.

The following price list of Robert Schreiber & Co., the only important refrigerator-manufacturers in this district, will serve to show the sizes, formation, and prices of the refrigerators of a modern type in use here. The factory of Robert Schreiber & Co. is situated at Nos. 120–122 Adalbertstrasse, Aix-la-Chapelle.

PRICE LIST AND DESCRIPTIONS.

Refrigerators of solid, tasteful form, in fine polished oak. The sides of the ice-box are provided with lattices, through which the ice cools the refrigerator directly, preventing almost entirely the gathering of sweat-water, and securing a very low temperature. The ice-box is in this way better calculated to resist the pressure of the ice from within. For convenience in cleaning, the ice-box can be taken out. Upon the outer side of the refrigerator is a nickled faucet to carry off the ice-water.

	Doors.	Gratings.	Height.	Breadth.	Depth.	Weight.	Price.
			Centimeters.	*Centimeters.*	*Centimeters.*	*Kilograms.*	*Marks.*
No. 1	1	1	74	61	49	40	33
No. 2	1	1	80	77	58	62	44
No. 3	1	2	86	80	60	70	55
No. 4	1	2	103	82	64	83	66
No. 5	2	2	80	106	60	82	77
No. 6	2	4	86	108	62	90	95
No. 7	2	4	103	120	65	140	105
No. 8	2	6	121	123	67	175	120
No. 9	2	8	150	132	70	215	165
No. 10	2	8	173	143	76	285	195
No. 11	2	8	189	187	88	415	280
No. 12	2	10	200	200	88	520	420

7a. One door with 2 gratings upon the right side, the ice-box occupying the left side. Fish can be placed directly upon or between the ice. Practical for fish, vegetable-dealers, etc.

103 cm. height; 120 cm. breadth; 65 cm depth; 150 kilos.

Nos. 10, 11, and 12 have three bolts by means of which the door is tightly closed above, below, and in the middle.

Beer refrigerators, with and without place for articles of food, are delivered in every size and form; also refrigerators for *restaurateurs*, etc.

Refrigerators of fine polished oak, specially adapted for butchers, three gratings upon the left side and one upon the right side. On both sides, above, heavy rods with meat hooks, and on the right side of the ice-box, rods with smaller hooks for smaller pieces of meat.

	Doors.	Gratings.	Height.	Breadth.	Depth.	Weight.	Price.
			Centimeters.	*Centimeters.*	*Centimeters.*	*Kilograms.*	*Marks.*
No. 9	2	4	150	132	70	215	165
No. 10	2	4	173	143	76	285	195
No. 11	2	4	189	187	88	415	280
No. 12	2	4	200	200	88	520	420

Refrigerators in solid form, which may be conveniently taken apart. On the left, two large gratings; above, on both sides, heavy rods provided partly with ordinary meat-hooks and partly with movable hooks. On the right side of the ice-box, rods with small hooks. In these refrigerators there is room for the largest pieces of meat. The dimensions are those of the body of refrigerators, not actual measurements as above, inasmuch as a cornice 11 centimeters wide projects on both sides and in front and this cornice is not included in the given dimensions. The entire form and finish of this refrigerator are ornamental.

	Doors.	Height.	Breadth.	Depth.	Weight.	Price.
		Centimeters.	*Centimeters.*	*Centimeters.*	*Kilograms.*	*Marks.*
No. 13	2	230	200	100	850	500
No. 14	2	230	220	120	1,000	600

Refrigerators Nos. 10–14 are provided with bolts, by means of which the door is tightly closed above, below, and in the middle.

We deliver on command all refrigerators with ice-box above, provided with a new patent drop-contrivance, by which, through lattices, the cooling process follows directly, preventing the gathering and falling of sweat-water, which in the case of ice-boxes above, tightly closed, takes place to a great extent.

The prices of these refrigerators, in accordance with size, is greater by 3-20 marks.

It will be seen from this report that the refrigerator industry in this district is still in its infancy. I have spoken with several well informed men touching the matter. All had seen our American refrigerators and thought them much superior to the German in form and construction. In general, however, these American refrigerators are not known here and can only be introduced through judicious advertising, either through the press indirectly or directly through representatives of American houses. All are ready to admit the superiority of many American manufactures, and yet all have the idea that these articles are much more expensive than those of home production. Lack of definiteness in advertising is largely responsible for the misunderstanding which prevails so extensively in this respect.

It is the fact that in this district, except in wealthy families and large hotels and markets, refrigerators are generally of the most primitive form. Even in large hotels I have found ice-boxes consisting simply of a wooden box lined with zinc. This is the form of refrigerator usually found in shops of small dealers in perishable goods.

Up to within a few years ago very little attention was paid to the form or construction of refrigerators. Every carpenter and tinman was considered qualified to manufacture them, and even to-day most of the ice-boxes are ordered in this way.

Ice for the most part is manufactured in this district, the ratio between natural and artificial ice varying of course with the severeness of the winter. There are three ice factories in Aix-la-Chapelle, and ice can also be obtained from some of the largest breweries and also from dealers in natural ice. It is seldom, however, that natural ice attains a thickness of 6 inches here at Aix-la-Chapelle. It is often harvested when but 2 inches thick. Lack of means of transportation prevents the importation of natural ice from the mountainous portions of the district.

The price of ice varies greatly, as in America, from 50 pfennige to 3 marks per 100 pounds. Prices depend, as with us, upon contracts, upon quantity bought, upon season of the year, upon winter, whether mild or cold.

JAMES RUSSELL PARSONS, JR.,
Consul.

UNITED STATES CONSULATE,
Aix-la-Chapelle, February 1, 1890.

ANNABERG.

REPORT BY CONSUL HUBBARD.

The consular district of Annaberg, by reason of its elevation and latitude, is practically one immense refrigerator during almost the entire year. Lying wholly in the Ertzgebirge or Ore Mountains, on the northern border of Bohemia, at an average elevation of 2,000 feet, and in the same latitude as Labrador, in British America, the inhabitants rarely, if ever, experience an uncomfortably warm day, and *never* an uncomfortably warm night. On this great plateau, extending from the Elbe to Voigtland and embracing some of the wildest scenery in Europe, there are no natural ponds and the mountain streams are exceedingly variable, with steep and rocky beds, sometimes filled with wild, roaring torrents and again as dry and dusty as the highway in summer.

Ice is only obtained here from artificial ponds, but fortunately, and in obedience to the law of compensation, the demand for it is very limited and it is regarded as an article of luxury, not of necessity.

As before remarked the elevation and latitude are quite sufficient to insure refrigeration of both liquids and solids.

Other means than the use of ice, however, are sometimes employed here to secure the preservation of food in a condition which will not be prejudicial to the health of the inhabitants. It is a well known fact that no article of diet suffers so quickly by exposure to heat as fish, but artificial refrigeration is not required for the preservation of fish in the Ertzgebirge, as the sale of dead fresh fish is here forbidden by law. It was to me a most interesting sight to be shown the other day an enor-

mous carp swimming contentedly about in a tub in my own kitchen. I had ordered fish for dinner the next day and the *Dienstmädchen* wished me to examine this sample, or *Muster*, as she called it and inform her whether it was satisfactory or not. The servant lifted the scaly visitor out of the water, opened and carefully examined its mouth, scrutinized its fins and scales, and explained to me that all appearances indicated the fish was in a normal state of health and entirely fit for a consul's table; to all of which this dull, phlegmatic carp submitted with the most touching resignation. It was pronounced in every respect satisfactory and again returned to its native element in the tub.

I will also remark that, with regard to hares, partridges, pheasants, and similar game, it is quite a common custom to hang them out of an attic window for three or four weeks, for the purpose it is said, of improving the flavor and it is claimed that exposure to the pure, dry, mountain air, always rich in ozone, is better than placing them in a close refrigerator.

From the foregoing statement of climatological facts it is readily seen that a good cellar in the Ertzgebirge fully meets the exigencies of the people in the preservation of food and drink and that this consular district does not offer a very brilliant prospect for the introduction and sale of American refrigerators.

I will now answer, categorically the questions proposed by the Department.

Refrigerators are used in this consular district to a limited extent, but their use is generally confined to the wealthy residents of cities.

Refrigerators which I have examined in Annaberg do not differ materially from, and are equal in all respects to, those which I have seen and used in America.

No refrigerators are manufactured in this district. I am informed that those used here are all made in Dresden.

The following tabulated statement of sizes and prices is taken from a price-list given me by Mr. G. Kirchhof, jr., a merchant of the city of Annaberg and sole agent for refrigerators in this district, so far as I know.

Height.	Width.	Depth.	Price.	Height.	Width.	Depth.	Price.
Inches.	*Inches.*	*Inches.*		*Inches.*	*Inches.*	*Inches.*	
31½	26	21	$7.25	44	34½	28	$15.50
34	32	25½	8.50	36½	46	26½	18.00
36½	33½	27	10.50	44	52	28	19.00
21½	40	21	10.00	64	56½	29½	34.00
34	32	25½	11.00	89	80	38	70.50
34	46	25½	13.50	93	93	40	100.00

Ice is secured in this district from small artificial ponds, and is delivered for about 20 cents per 100 pounds. The demand for it is very limited.

I would advise any American manufacturer, who desires to introduce his refrigerators into this district, to communicate with Mr. G. Kirchhof, jr., of Annaberg, a merchant of the highest honor and integrity.

I will add that the German Government imposes an import duty of about $1 per 100 pounds weight on refrigerators.

DANIEL B. HUBBARD,
Consul.

UNITED STATES CONSULATE,
Annaberg, January 28, 1890.

BERLIN.

REPORT BY CONSUL-GENERAL EDWARDS.

I have the honor to report that upon the receipt of the refrigerator circular of November 25 last, I addressed thirty-two separate inquiries to the manufacturers of and dealers in refrigerators in Berlin with regard to their prices, etc.

The sizes, formations, and prices of the refrigerators in use in this district may be seen from an examination of the price lists which accompany this report.

Ice is secured in the ordinary way from the river here which flows through the city, and is stored as with us in an ice-house built for the purpose. The price of the ice ranges from 50 pfennig to 70 pfennig per centner.

It occasionally happens that on account of an open winter the Berliners are compelled to send to Sweden for their ice, in which case the price is much dearer.

By an examination of the following illustrations the American manufacturers can readily see what chances they have in this market.

W. H. EDWARDS,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin.

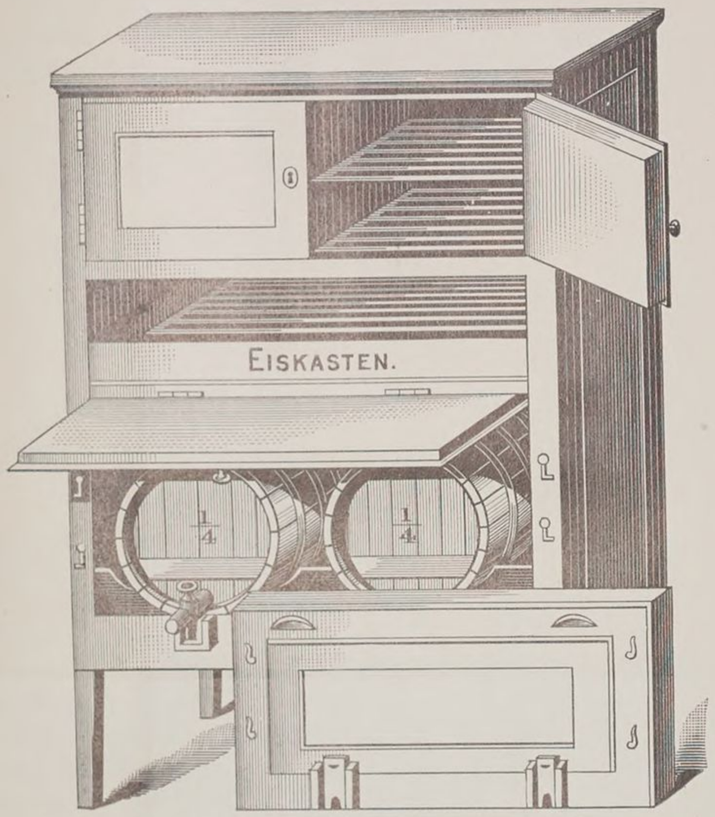
CHEMNITZ.

REPORT BY CONSUL MERRITT.

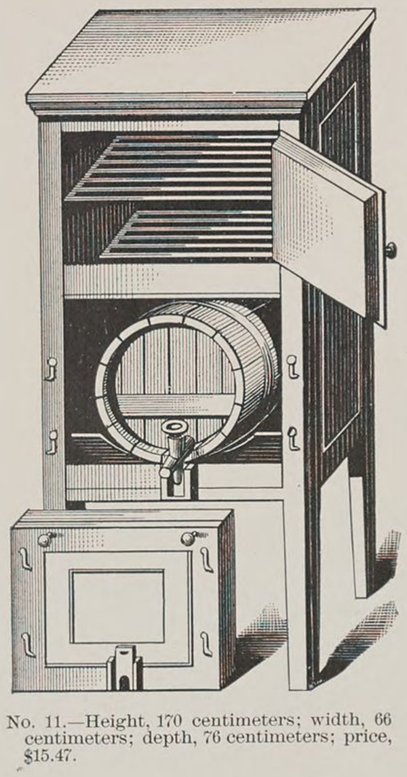
Refrigerators are used quite extensively in this consular district, being found in all restaurants, saloons, meat-shops, etc., and in the houses of most well-to-do private families.

Refrigerators are built here on the same principles and in the same style as in the United States, there being a number of manufacturing establishments engaged exclusively in this line.

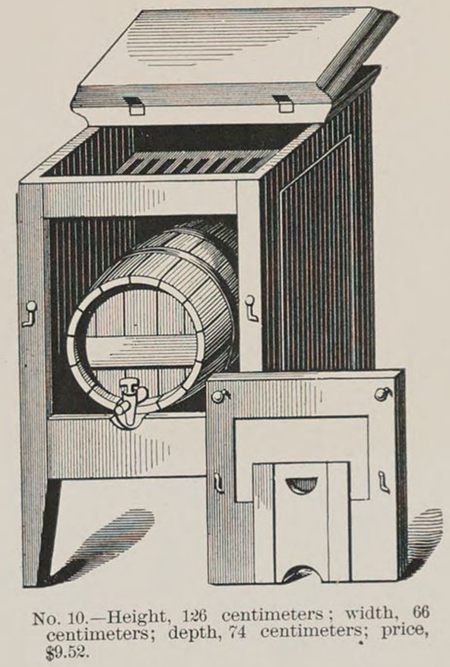
REFRIGERATORS IN GENERAL USE IN BERLIN.



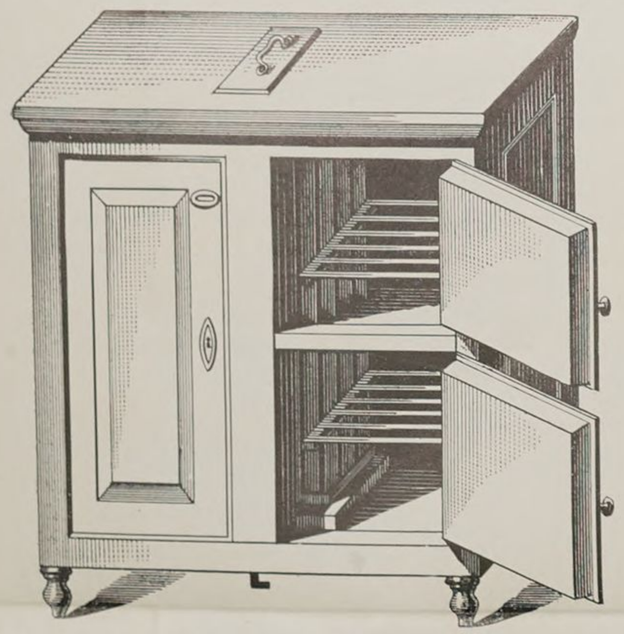
No. 12.—Height, 194 centimeters; width, 116 centimeters; depth, 76 centimeters; price, $33.32.



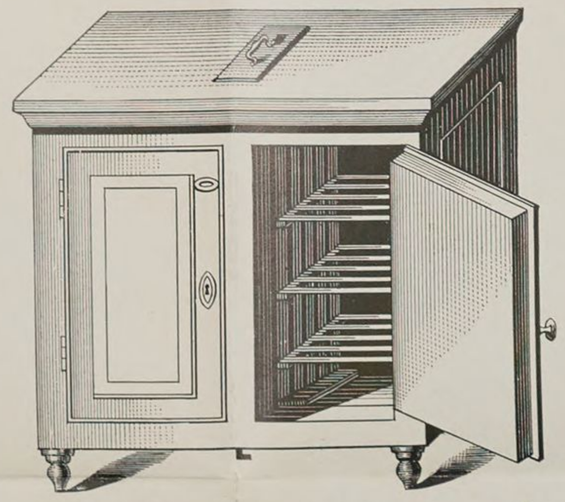
No. 11.—Height, 170 centimeters; width, 66 centimeters; depth, 76 centimeters; price, $15.47.



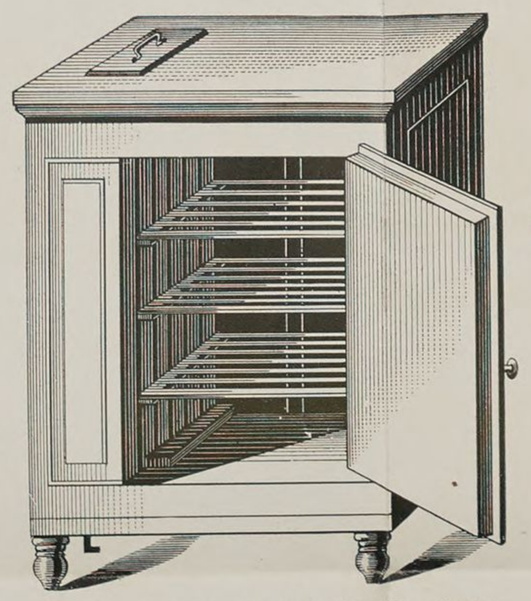
No. 10.—Height, 126 centimeters; width, 66 centimeters; depth, 74 centimeters; price, $9.52.



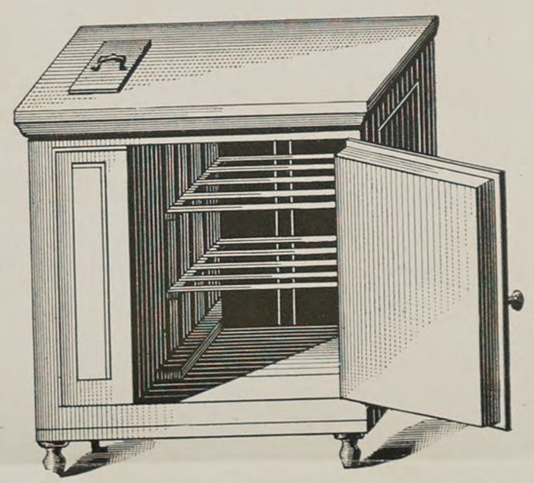
No. 9.—Height, 128 centimeters; width, 131 centimeters; depth, 66 centimeters; price, $25.08.



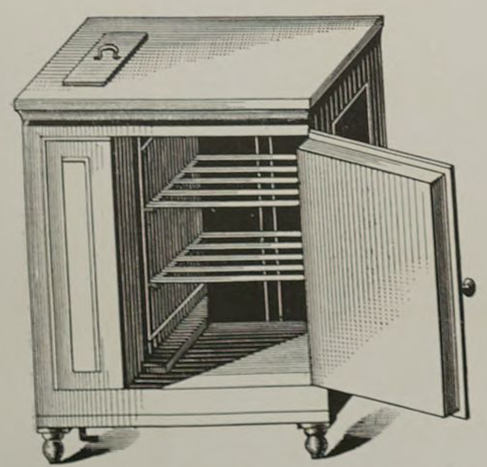
No. 8.—Height, 105 centimeters; width, 107 centimeters; depth, 61 centimeters; price, $15.70.
No. 8a.—Height, 113 centimeters; width, 115 centimeters; depth, 61 centimeters; price, $17.14.



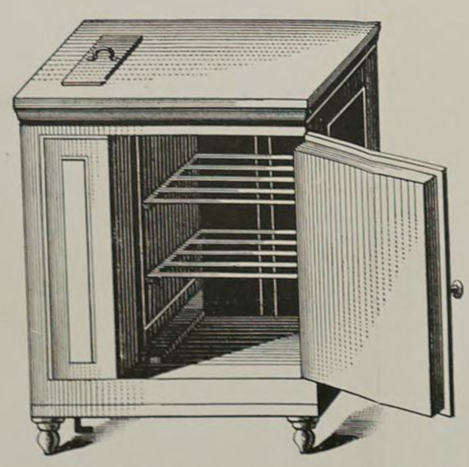
No. 7.—Height, 112 centimeters; width, 79 centimeters; depth, 60 centimeters; price, $12.88.



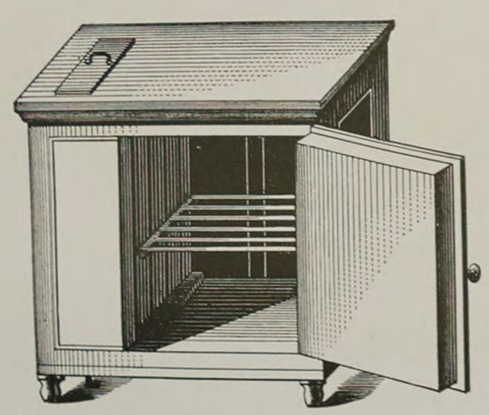
No. 6.—Height, 105 centimeters; width, 100 centimeters; depth, 58 centimeters; price, $12.64.



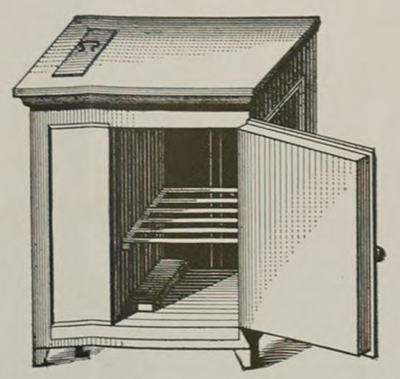
No. 5.—Height, 97 centimeters; width, 84 centimeters; depth, 56 centimeters; price, $10.



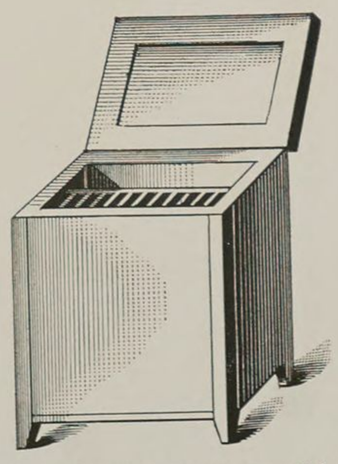
No. 4a.—Height, 89 centimeters; width, 84 centimeters; depth, 56 centimeters; price, $9.28.
No. 4.—Height, 89 centimeters; width, 75 centimeters; depth, 51 centimeters; price, $8.57.



No. 3.—Height, 80 centimeters; width, 78 centimeters; depth, 54 centimeters; price, $7.85.



No. 2a.—Height, 74 centimeters; width, 72 centimeters; depth, 51 centimeters; price, $6.43.
No. 2.—Height, 74 centimeters; width, 66 centimeters; depth, 50 centimeters; price, $5.95.



No. 1.—Height, 67 centimeters; width, 47 centimeters; depth, 46 centimeters; price, $3.57.

In size the refrigerators here used run all the way from the large ones used by butchers and restaurant keepers down to the small boxes used in private families for keeping small quantities of butter, milk, etc., fresh.

As in the United States refrigerators are here made of various kinds of wood, are usually finished in oil, and are lined with plate zinc.

The prices may be stated as follows:

Weight.	Height.	Width.	Depth.	Doors.	Compartments.	Price.	
						In oil.	Varnished.
Pounds.	*Inches.*	*Inches.*	*Inches.*				
80	28	30	24	1	2	$8.50	$9.25
90	36	30	24	1	2	11.50	12.50
125	44	30	24	1	4	15.50	16.75
160	52	30	24	2	4	20,25	21.50
185	44	44	24	2	6	23.75	25.75
210	60	46	24	2	8	28.50	31.00

The above prices are for retail with 4 per cent. off for cash. They are also sold on the installment plan on easy terms, at about the rates given above. The prices on larger sizes are proportionately greater.

For medicinal purposes artificial ice is used, and is sold all the year round at 1.30 marks per 100 pounds (German) equal to about 27 cents per 100 English pounds. For purposes other than medicinal, natural ice is used. This is very cheap, though only of medium quality, being delivered in winter at 15 to 20 pfennig ($3\frac{1}{2}$ to $4\frac{3}{4}$ cents) per 100 pounds. In the summer the price of ice is higher, but never passes above 50 pfennig, or 12 cents per 100 pounds.

The principal use to which ice is put is to keep beer and meat cold. All breweries furnish the necessary ice to their customers free of charge, and the same rule applies between the large butchers and the retail meat dealers.

For the manufacture of artificial ice, machinery of the most improved and scientific nature is employed. But ice-cutting and harvesting machinery is practically unknown, and ice on rivers and ponds is cut and harvested by hand in the old-fashioned process.

After consideration of the whole subject, I can hardly view the introduction of American refrigerators into this consular district as practicable. Refrigerators are sold here at quite as low prices as in the United States, and the freight on such bulky articles, together with the German import duty (10 marks per 100 kilograms—$1.10 per 100 pounds), would seem to shut out American competition completely.

HENRY F. MERRITT,
Consul.

UNITED STATES CONSULATE,
Chemnitz, March 8, 1890.

COLOGNE.

REPORT BY CONSUL WAMER.

Refrigerators are extensively used in this district, and almost every well-situated family is provided with one.

There are different styles. The oldest and best known refrigerator is constructed in such a manner that the space for the ice is on the side; this is, however, only for the smaller-sized ones. In the larger refrigerators the space for the ice is in the middle. A new style, by some considered the best one, has been patented by Mr. Alex. Heberer, of Mannheim. His refrigerator is constructed in such a manner that the space for the ice is on the top. The inclosed designs, "Refrigerators in general use in Cologne," show the different styles referred to.

Most of the refrigerators used in this district are manufactured in Dresden, Düsseldorf, and Gaggenau in Baden.

Ice is manufactured in all the larger towns in this district. There are three manufactories in this city. The price varies according to quantity ordered. For small amounts the price is 24 cents and for large amounts 17 cents per centner (centner equal to about 100 pounds).

W. D. WAMER,
Consul.

UNITED STATES CONSULATE,
Cologne, February 13, 1890.

CREFELD.

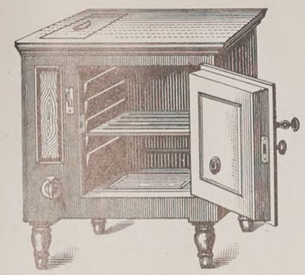
REPORT BY CONSUL BLAKE.

Refrigerators are in general use, not only in private families, but in hotels, wine and "restauration" dining-rooms.

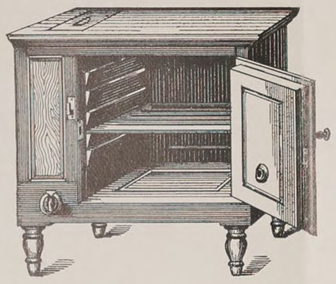
All refrigerators are constructed with the ice reservoir either in the center or on the side of the zinc or porcelain lining, which will be explained more fully in answer to question 4.

Those in use in this district are manufactured in the local towns, and are largely manufactured in the city of Crefeld and shipped to the smaller towns of this district. They are made in all sizes, ranging from 3 to 10 feet square. The material used for the outside is fir wood. The lining is generally zinc, but occasionally porcelain is used about one-half an inch thick and 6 to 8 inches square. The smaller sizes have only one door, and are only in use by private families. The ice reservoir in this size is on the side and extends from the top of the refrigerator to the bottom of the zinc lining, and has a faucet at the bottom for drinking-water. Some have drainage only under the refrigerator. The larger sizes have two doors in front, with ice reservoir in the center, extending also from the top of the refrigerators to

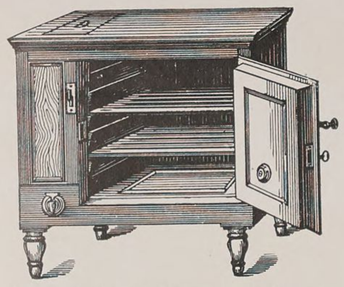
REFRIGERATORS IN GENERAL USE IN COLOGNE.



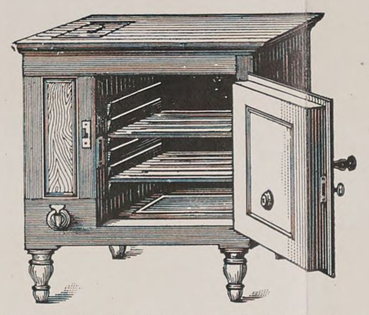
No. 1.—Height, 76 centimeters; width, 65 centimeters; depth, 50 centimeters.



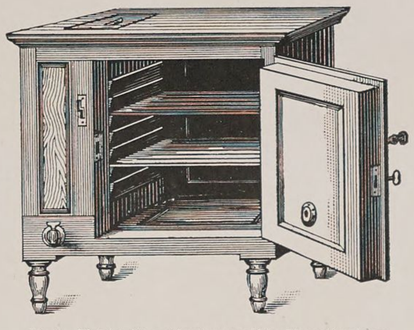
No. 2.—Height, 80 centimeters; width, 81 centimeters; depth, 56 centimeters.



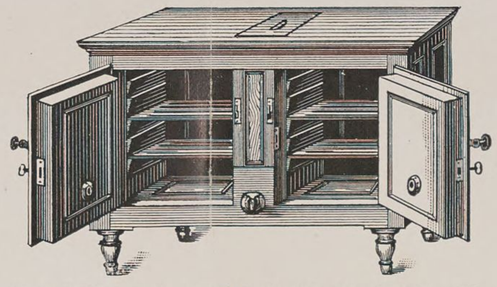
No. 2a.—Height, 80 centimeters; width, 81 centimeters; depth, 56 centimeters.



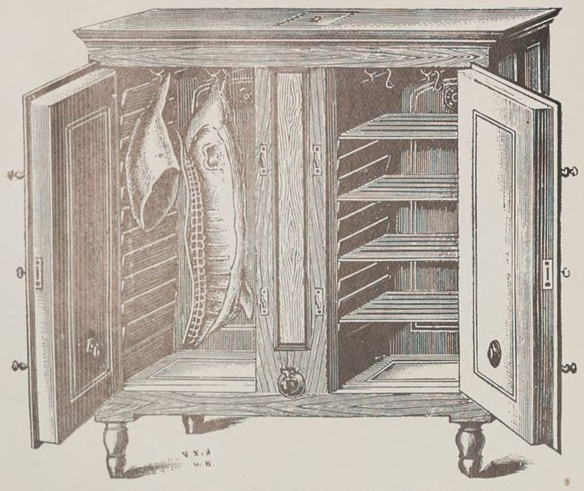
No. 3.—Height, 91 centimeters; width, 81 centimeters; depth, 57 centimeters.



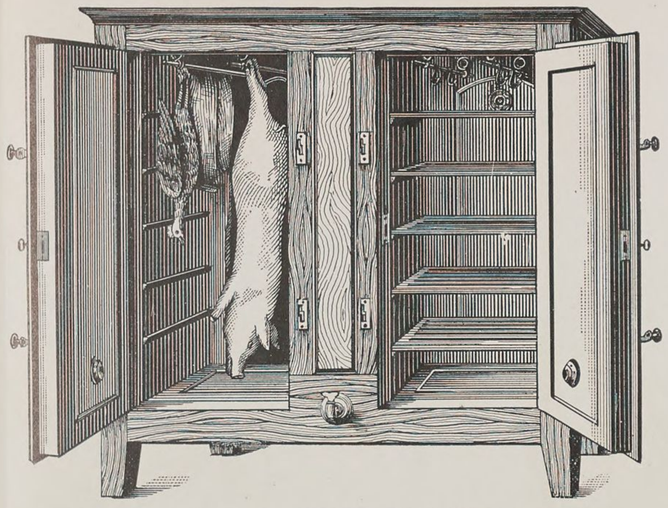
No. 4.—Height, 97 centimeters; width, 94 centimeters; depth, 60 centimeters.



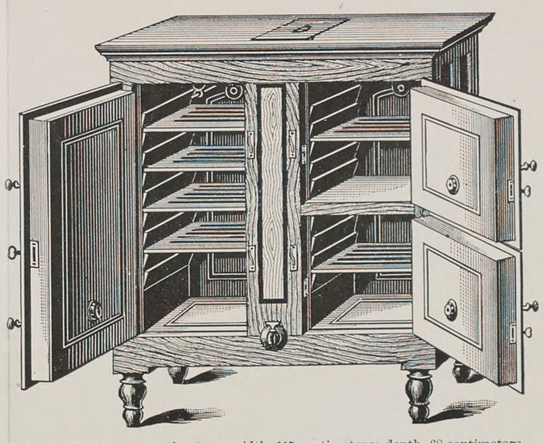
No. 5.—Height, 81 centimeters; width, 110 centimeters; depth, 60 centimeters.



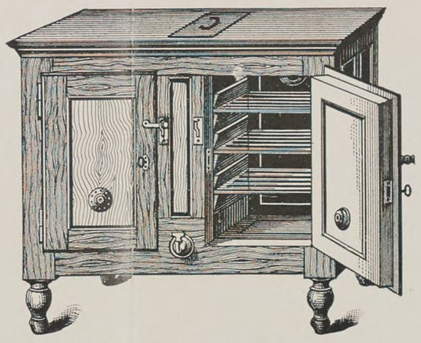
No. 11.—Height, 155 centimeters; width, 137 centimeters; depth, 73 centimeters.



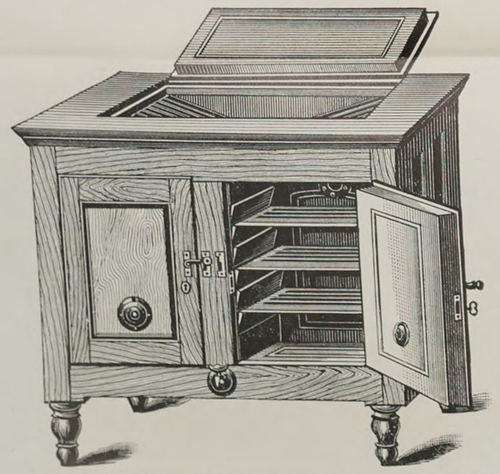
No. 12.—Height, 188 centimeters; width, 185 centimeters; depth, 88 centimeters.



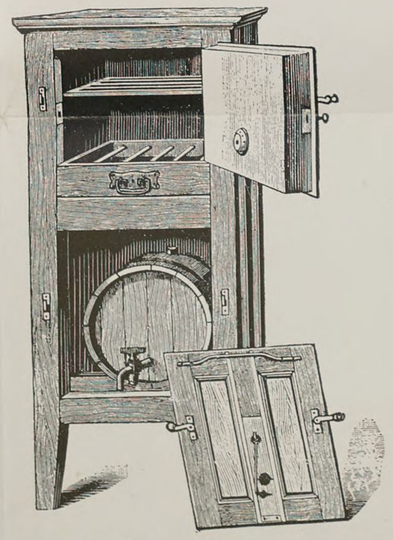
No. 7.—Height, 133 centimeters; width, 115 centimeters; depth, 68 centimeters.



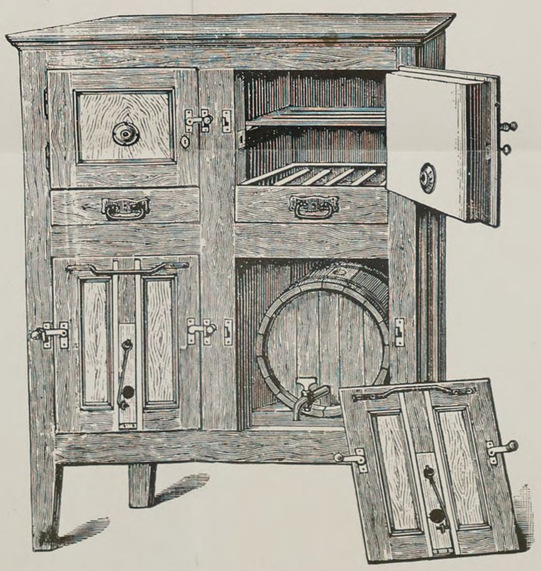
No. 6.—Height, 102 centimeters; width, 110 centimeters; depth, 60 centimeters.



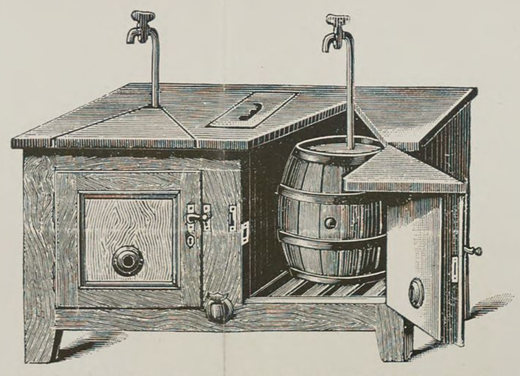
No. 20.—Height, 120 centimeters; width, 130 centimeters; depth, 75 centimeters.



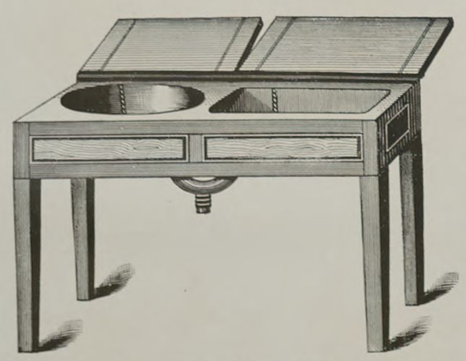
No. 9.—Height, 170 centimeters; width, 72 centimeters; depth, 72 centimeters.



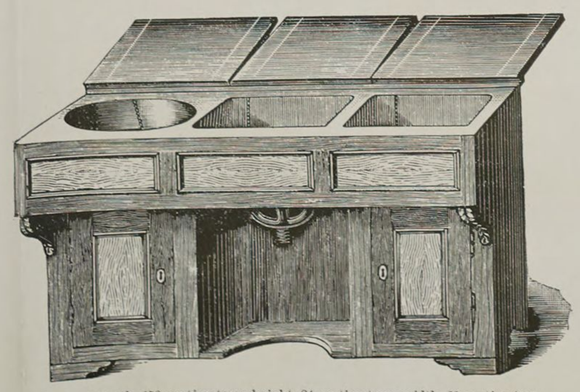
No. 10.—Height, 184 centimeters; width, 140 centimeters; depth, 84 centimeters.



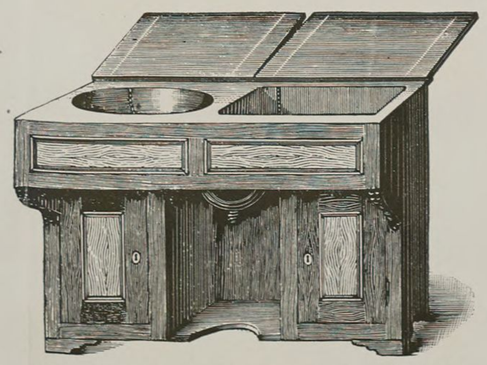
No. 8.—Height, 83 centimeters; width, 145 centimeters; depth, 67 centimeters.



No. 1.—Length, 115 centimeters; height, 82 centimeters; width, 58 centimeters.



No. 4.—Length, 150 centimeters; height, 84 centimeters; width, 60 centimeters.



No. 3.—Length, 115 centimeters; height, 82 centimeters; width, 58 centimeters.

No. 13.—Height, 65 centimeters; width and depth same as height.

the bottom of the lining, and have faucets at the bottom for drinking-water. The ice reservoir is usually made of zinc, occasionally of porcelain, and made water-tight nearly to the top, and then perforated with holes. All sizes of refrigerators have a dead air space between the wood and zinc or porcelain lining, and have an opening at the top, with a movable zinc-lined cover, through which the ice is put into the reservoir.

Refrigerators in use in meat markets have iron rods inside, near the top, provided with movable iron hooks.

Wine and dining "restaurations" have a peculiar refrigerator, usually made of carved and polished walnut, placed upon the counter in the dining room. This refrigerator is lined with zinc and has a dead-air space of about 2 inches. In the inside of this reservoir there are three or four separate coils of lead-pipe with a faucet attached to each from the outside. Beer and other kinds of liquor are forced through these pipes by means of an air-force pump.

The prices of refrigerators range from $10.47 to $95.20 and upwards, as the following table will show:

	Sizes.	Price.
	Feet.	
One door	3 by 3	$10.47
Do	3½ by 3	12.61
Two doors	4 by 3	18.08
Do	6 by 6	59.97
Do	7 by 8	84.25
Do	7½ by 8	95,20

The refrigerators lined with porcelain and furnished with ice reservoirs cost about 25 per cent more than those lined with zinc.

The weather in this locality is so mild that ice can not be obtained in sufficient quantities to supply the demands and needs of this city and locality; therefore ice-factories have been established to supply this demand. There are now three ice-factories in active operation. Ice is furnished in large quantities for 28½ cents per 100 pounds and in small quantities for family use as follows:

	Weight.	Price per month.
	Pounds.	
One-half block	10	$1.78
One block	20	2.38
Two blocks	40	3.57

EVANS BLAKE,
Consul.

UNITED STATES CONSULATE,
Crefeld, February 25, 1890.

DRESDEN.

REPORT BY CONSUL PALMER.

Refrigerators are used to a very large extent in this consular district and there is hardly a hotel, restaurant, or household of any extent without one.

They are constructed in different sizes to suit various purposes. It is the general feature of these refrigerators to have one ice compartment and a second compartment for the food and liquid to be preserved. The refrigerator is generally divided by a vertical partition, the one compartment being in its lower part provided with a grating for the ice to rest on and to keep clear of the melting water, the other compartment being divided by horizontal boards to receive the articles to be preserved. In larger refrigerators the ice compartment is arranged in the middle of the furniture, the two sides forming the two compartments for receiving the articles to be preserved, the walls of the refrigerators being made double and filled with a non-conductor of heat, all the inner walls, grating, and boards in the refrigerator being covered with zinc.

The sizes, formations, and prices are varying. The refrigerators of this establishment are of oak, varnished, lined with strong zinc, and with all latest improvements. Nos. 1 to 4, one door; Nos. 5 to 8, two doors.

The measures are in centimeters for the height, width, and depth, and the prices in marks. These refrigerators are, of course, of the smaller kind and for household purposes.

Ice is stored here in cellars or in so-called "Americans," that is, overground, in light houses with double walls. The price for storing ice varies according to the character of the winter. It costs from 10 to 25 pfennig, all included, breaking, loading, carriage, and storage, per 100 pounds.

It is sold, according to variations of first costs, at subscription by the owner of the storage cellars to hotels, restaurants, and households. It is very often made a point by the restaurants that the brewery delivering the beer shall supply the ice gratis.

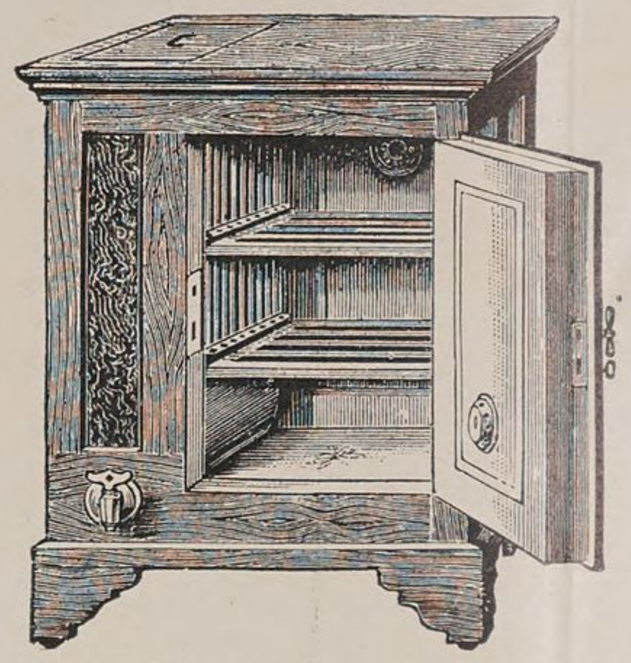
Formerly the refrigerators were especially constructed to receive casks with beer. This system is generally abandoned on account of the system for raising the beer in pipes by air pressure, the beer passing through a refrigerator consisting of a closed vessel filled with ice, through which the beer-pipe passes as a coiled serpentine.

In regard to the best manner of introducing refrigerators into this consular district, I can only say that the ordinary trade way of having them properly exhibited by a competent agent would be most likely to succeed.

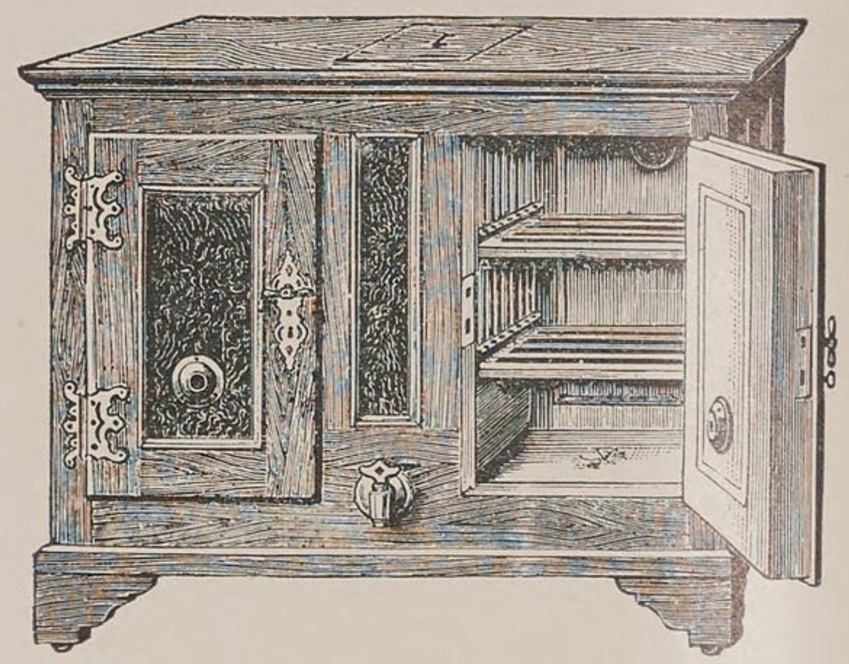
AULICK PALMER,
Consul.

UNITED STATES CONSULATE,
Dresden, March 12, 1890.

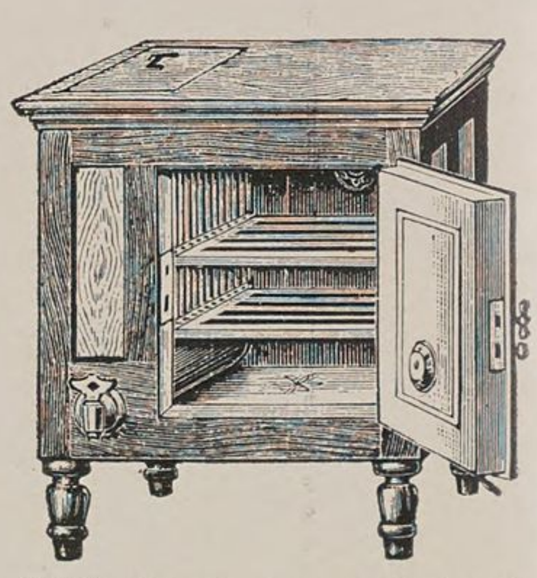
REFRIGERATORS IN GENERAL USE IN DUSSELDORF.



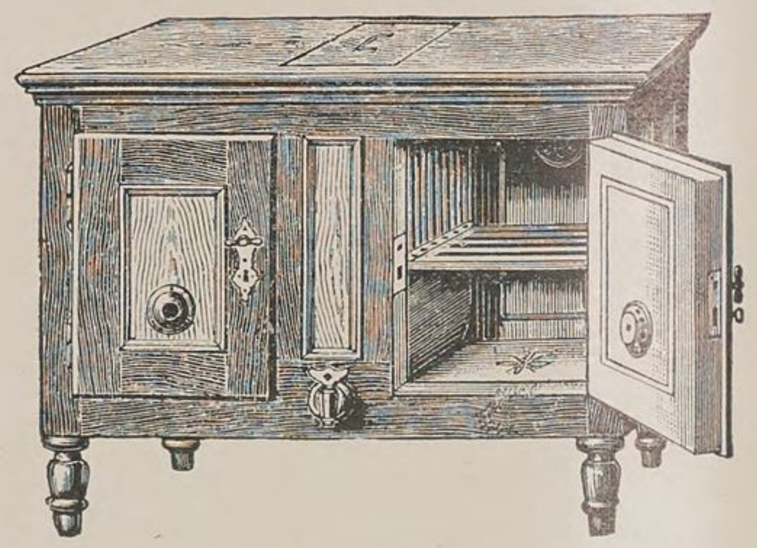
Height, 103 centimeters; width, 84 centimeters; depth, 66 centimeters; price, $15.83.



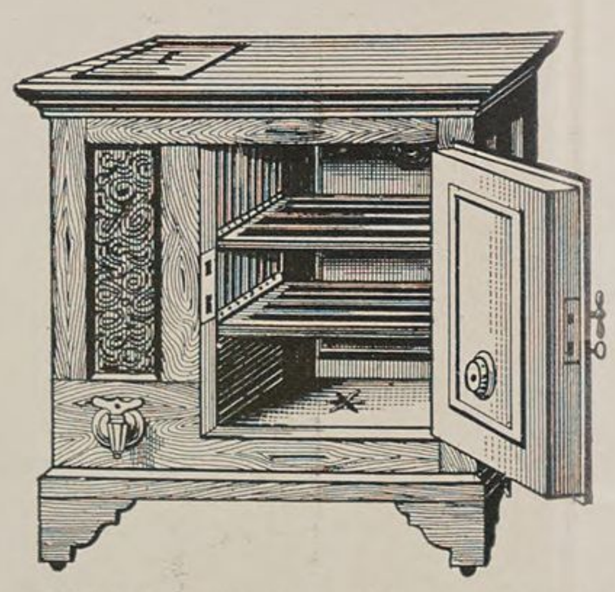
Height, 103 centimeters; width, 122 centimeters; depth, 66 centimeters; price, $22.85.



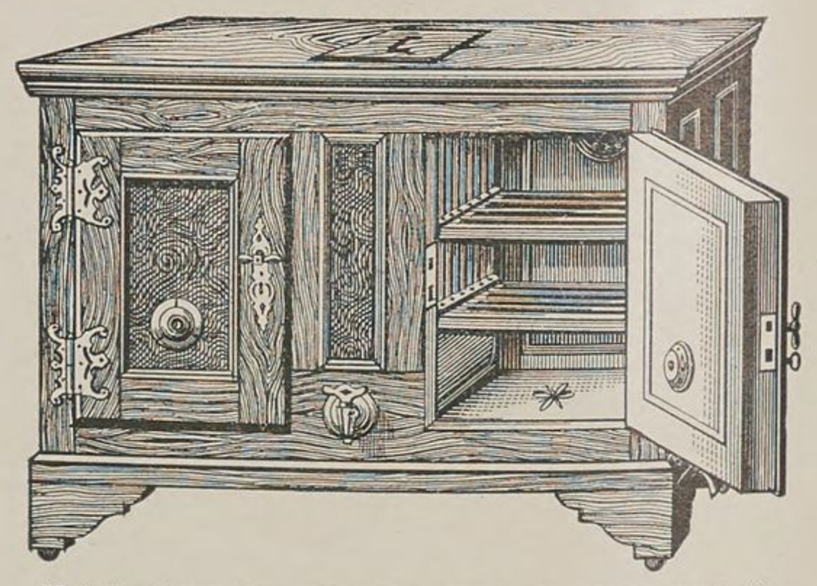
Height, 80 centimeters; width, 76 centimeters; depth, 60 centimeters; price, $10.



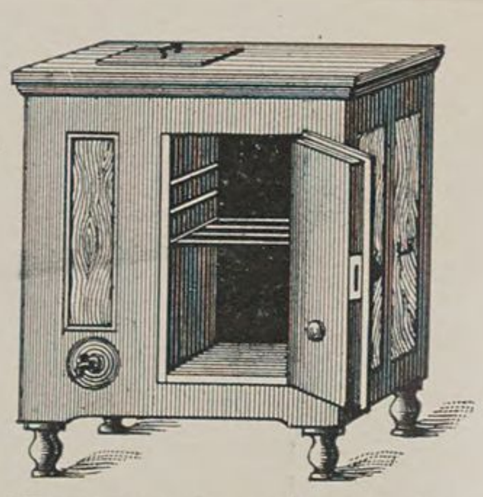
Height, 80 centimeters; width, 108 centimeters; depth, 60 centimeters; price, $13.09.



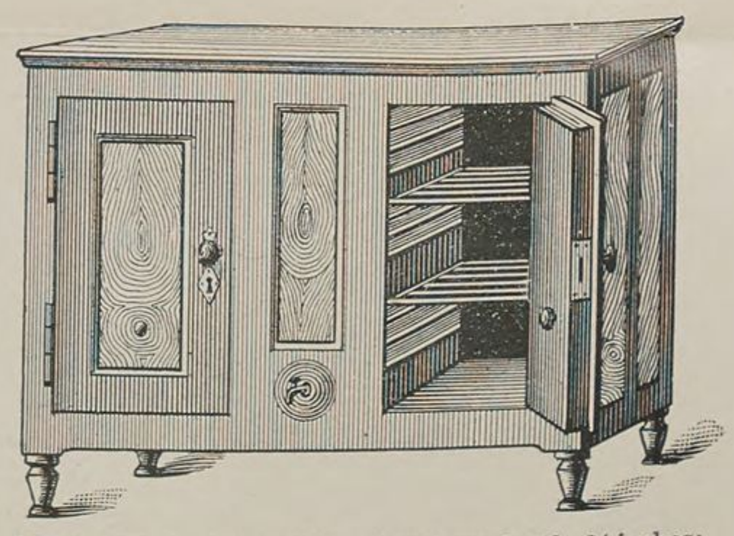
Height, 89 centimeters; width, 79 centimeters; depth, 63 centimeters; price, $13.09.



Height, 89 centimeters; width, 108 centimeters; depth, 63 centimeters; price, $17.85.



Height, 30 inches; width, 24 inches; depth, 19½ inches; price, $7.14.



Height, 31½ inches; width, 42 inches; depth, 24 inches; price, $10.71.

DÜSSELDORF.

REPORT BY CONSUL PARTELLO.

Refrigerators are used in this consular district, but only within the last few years to any extent. On account of the location of the district in a northern latitude, the absence of great heat during the summer months, and the fact that most of the houses have good cellars, the necessity for their use seemed not to be felt until of late, except in the case of large ones constructed as a part of the business place of butchers, dairymen, etc.

The improvement that seems to be gradually making its way in the building of houses and in other comforts and conveniences in the domestic life of the Germans has among the better classes brought into general use refrigerators.

The peculiar features of refrigerators for this market are shown by the inclosure, "Refrigerators in general use in Düsseldorf," which shows the general plan of their construction.

The refrigerators used in this district are manufactured in the several cities within the district, the principal establishments being Düsseldorf and Cologne.

Ice is secured in this district from small lakes and ponds, a number of which are kept expressly for the purpose. They are carefully watched, kept clean, and specially cared for. The cutting and hauling is about the same in manner as is customary in the States, and ice-houses are built on the same general plan.

The price of ice per 100 pounds will average about 24 cents to hotels and restaurants; the rate to private consumers about 30 cents.

GENERAL REMARKS.

Refrigerators for use of hotels, butchers, and dairy stores are constructed as a part of the establishment. The plan is mostly of wood, with stone floors, hollow sides filled with sawdust; though numbers are built of stone, sometimes marble, laid in cement, and others neatly tiled on the outside. In regard to the American system of preserving food and liquids, it is believed with the knowledge the Germans have in this respect and the general use of refrigerators it would be a difficult matter to induce them to make any change.

The general plan of the new refrigerators manufactured here is fairly good, many ideas having been copied from the American goods, and on account of the duties, that would have to be paid, added to freight, and considering the reasonable price of those manufactured in Germany, it is my opinion that it would be a difficult matter to introduce with any profit the refrigerators of American manufacture within this consular district.

D. J. PARTELLO,
Consul.

UNITED STATES CONSULATE,
Düsseldorf April 19, 1890.

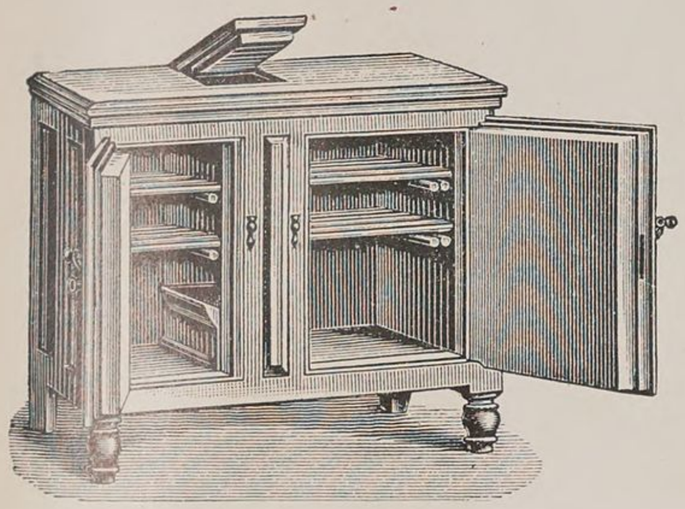
FRANKFORT-ON-THE-MAIN.

REPORT BY CONSUL-GENERAL MASON.

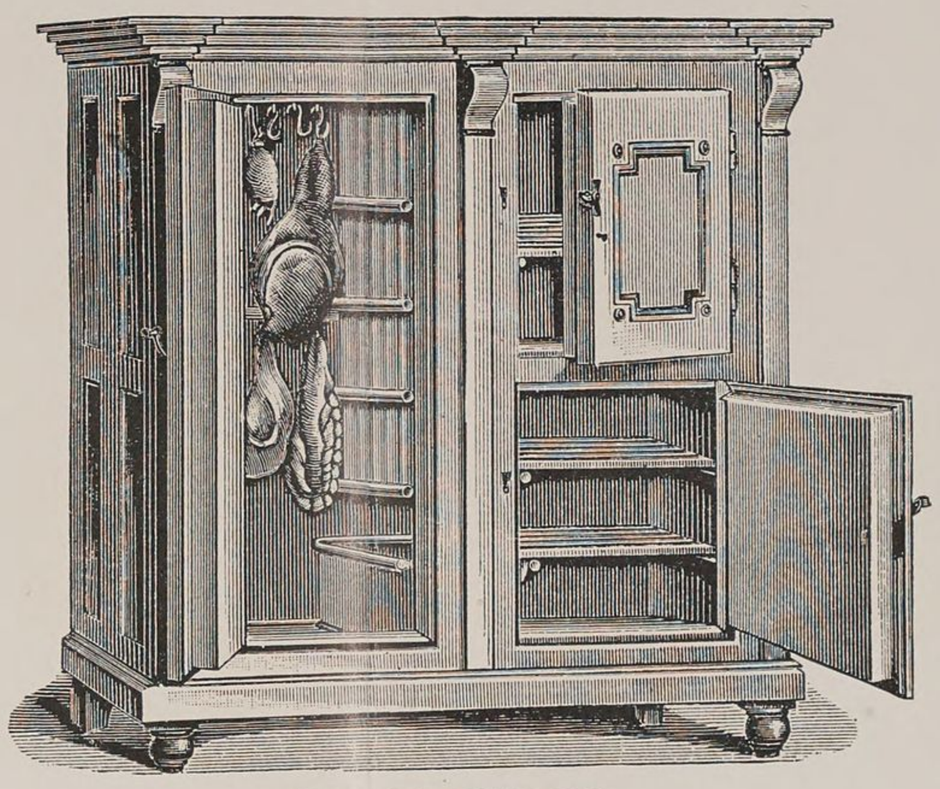
Refrigerators are very generally used in this district, particularly in Frankfort, where the average of wealth is high and the prevalent style of living luxurious and liberal. The use of ice for domestic purposes, which was considered a luxury a generation ago, is now regarded a necessity of daily life during the summer season. The use of ice in winter is far less general here than in the United States, for the reason that ice-water is rarely or never drank. Brewers and butchers use ice in this country precisely as they do in the United States. When winters are cold enough to furnish natural ice they gather it from ponds and overflowed meadows; when the natural supply fails they manufacture it, most of the large breweries being equipped with ice-making machinery of their own.

The refrigerators used in this vicinity are manufactured mainly by two large factories, one of which is located in Frankfort, the other in the neighboring village of Bockenheim. They are nearly all more or less literal copies of American or English ice-chests, and therefore can hardly be said to embody any important original features to distinguish them from the models from which they have been adopted. In answer to the queries concerning the sizes, formations, and prices of the refrigerators manufactured and used here, there is appended to this report a page from the illustrated circular of one of the local establishments already alluded to, which not only manufactures refrigerators at its factory in Bockenheim, a mile beyond the city limits of Frankfort, but has natural ice ponds and store-houses at Hanau, about 12 miles distant, and an artificial ice manufactory in this city from both of which ice is supplied and delivered to customers throughout the season the same as in American cities. As will be seen from the illustrations, the ice-chests offered do not differ essentially in form or construction from those in ordinary use at home. They are made of light wood, painted and grained to resemble oak or walnut, and are lined with zinc. In large chests the walls are double and filled with charcoal. The prices given in the circular are those of 1889. On account of the advance in the cost of coal and iron, mainly by reason of strikes among miners and iron workmen, the price-list of the coming season will be 10 per cent. higher than those printed in the circular, the equivalents of which are added in American currency. It will be seen that the prices given are low. This is true of all German copies of American machinery or appliances that I have examined. The quality is also more or less inferior to the original, particularly in respect to exterior finish and nicety of adjustment, but they are all good enough for every-day use, and their cheapness is an argument which, to the German purchaser, is decisive in favor of the home-made article.

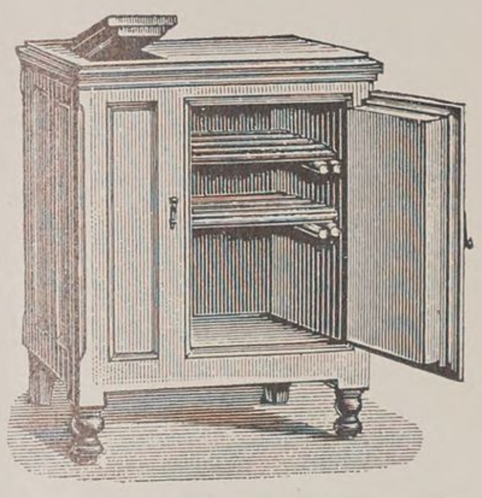
REFRIGERATORS IN GENERAL USE AT FRANKFORT ON THE MAIN.



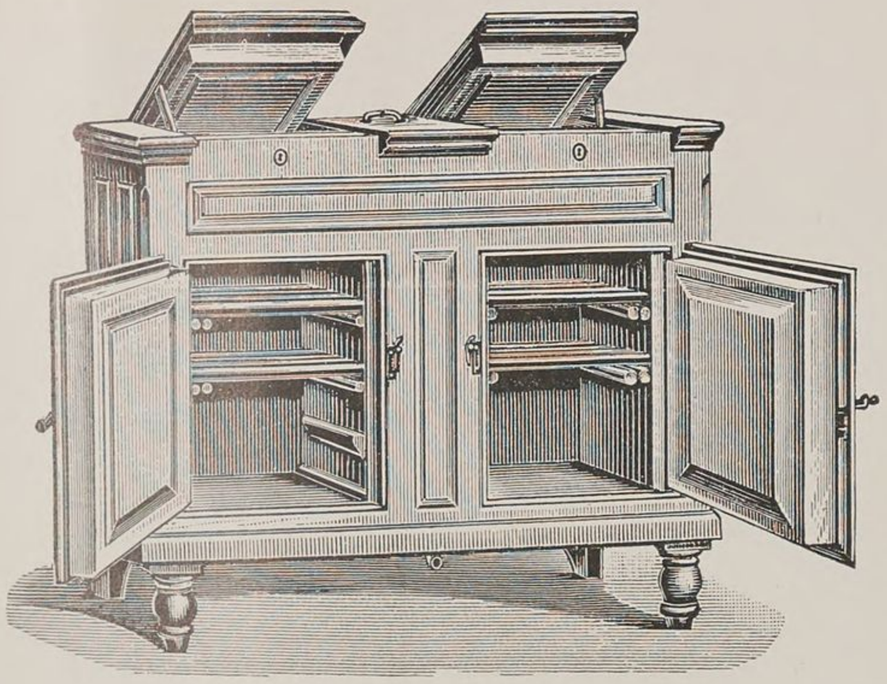
No. 6 and No. 6b.—Price, $10.71 to $13.09.



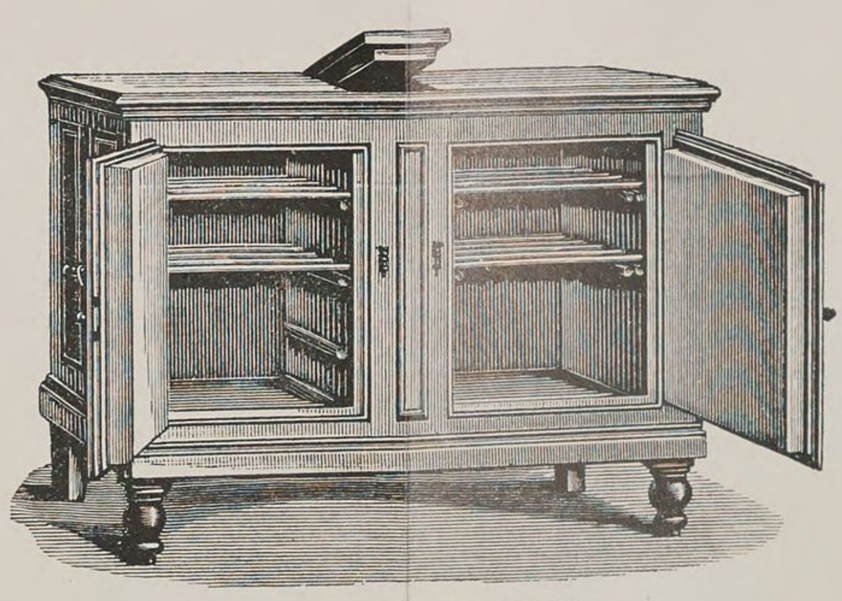
No. 15.—Price, $29.71 to $41.65.



Nos. 1-4.—Price, $4.28 to $9.52.

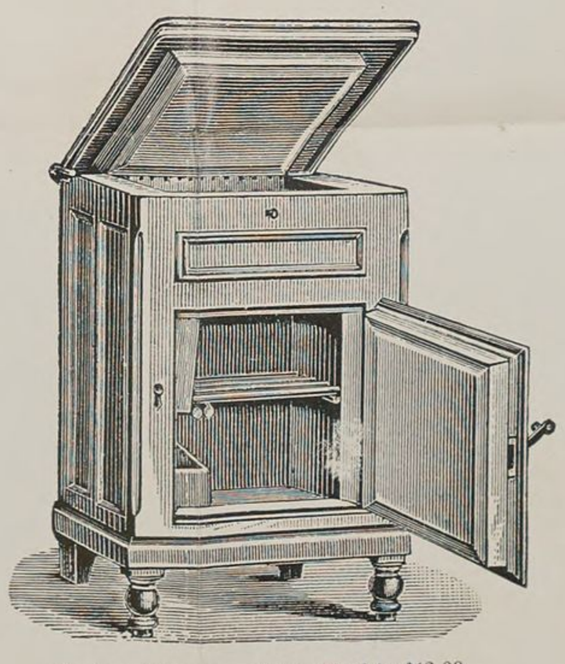


No. 9.—Price, $16.66 to $20.23.



No. 8.—Price, $16.66.

No. 6a.—Price, $15.47.



No. 5 and No. 5a.—Price, $8.56 to $13.09.

No. 7.—Price, $13.09 to $17.85.

Ice is secured in this district, as already intimated, both from natural and artificial sources. There are no large lakes in this region and the Main is too swift a stream to make thick ice except during the occasional severe winters, which are too rare and uncertain to be depended upon. But there are a number of small artificial ponds made by damming small streams, from which a fair supply is obtained in ordinary seasons.

From an illustrated catalogue before me it is apparent that the Germans have horse-plows, steam traction, and all the essential modern improvements in ice gathering. Their store-houses are of wood with the exterior walls filled with tan-bark, and in respect to convenience of equipment are in no respect inferior to the great establishments along the Hudson River. Prices vary according to the success which attends the harvest of natural ice and consequently the proportion of artificial ice which has to be made to meet the deficit in the natural supply. The schedule for 1890 has not yet been announced, but thus far little or no ice has been gathered, and as it is now probably too late to expect more than a limited harvest of thin and poor quality, it is probable that prices during the coming summer will be considerably higher than during the warm months of last year, which was a fair average season. The prices which ruled then may be accepted as the average for ordinary seasons and were as follows:

For daily delivery from April 12 until September 30. Per day for the season, 5 pounds, $4.28; 10 pounds, $5.99; 15 pounds, $8.33; 20 pounds, $10.

Monthly subscription for not less than thirty consecutive days, per day, 5 pounds, 3½ cents; 10 pounds, 4¾ cents; 15 pounds, 6 cents; 20 pounds, 7½ cents.

Persons living near the depots of the company in this city can save 10 to 15 per cent. from these prices by taking their ice from the depot instead of the delivery-wagons.

Coming finally to the main question whether there is in this district any practical field for the introduction and sale of American refrigerators, it would seem to follow from what has been already stated that the prospect is not highly encouraging. Some years ago refrigerators of the Brainard (American) pattern were introduced here by means of originals or copies, but they did not please and the effort was abandoned. If there is an American refrigerator capable of being made in suitable sizes and patterns for the varied uses of families, cafés, and hotels, and which, besides being superior to those in ordinary use, is so original and distinctive in construction that it can be protected by patent from indiscriminate imitation, there might be an opportunity here for its successful introduction. The duty on fixtures of that class imported from foreign countries is $1.19 per 220 pounds, but the bulkiness of such merchandise in proportion to its value would make the question of ocean freights of vital importance.

In the manufacture of artificial ice, or almost any industrial applica tion of chemistry or other kindred science, the Germans are masters and have little to learn from any other people. Their machinery implements, and many forms of manufacture lack originality and the perfection of finish and fitting which characterizes American goods, but they manage even in these departments to make something that will answer the purpose, and to make it cheap. In respect to a fixture so simple and easy to imitate as a refrigerator they would probably be very difficult people to compete with on their own ground.

FRANK H. MASON,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Frankfort-on-the-Main, January 31, 1890.

HAMBURG.

REPORT BY CONSUL JOHNSON.

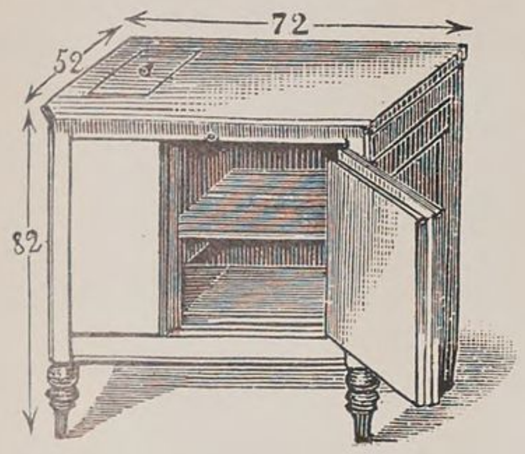
On receipt of the Department's circular of November 25, 1889, I applied to the proper Hamburg authorities for the information called for in the same; but, owing to the dilatoriness of these authorities, I was only furnished with a very unsatisfactory reply under date of March 10, 1890. This report being non-responsive to the interrogatories propounded in the Department's circular, I have endeavored to collect the information myself and submit the result below.

Refrigerators are used in almost every household in the towns and cities of this district; their use is, however, confined to the summer season alone, the cellars in most houses being sufficiently cool to preserve articles of food, etc., during the winter months. The restaurants and beer taverns, however, make an exception, using ice in their refrigerators almost throughout the year.

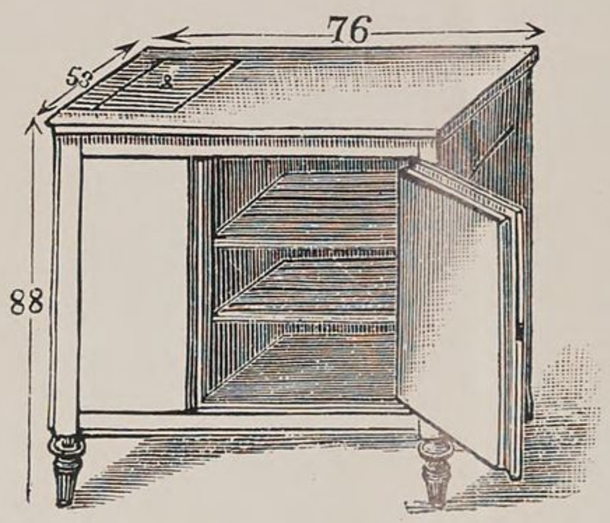
There are hardly any peculiar features required in the construction of the refrigerators. They vary in size only and consist of wooden cases lined with zinc, a space of a few inches between the wood and the metal being filled with thoroughly dried sawdust. Those in use in this district are mostly manufactured in Hamburg or Altona. As the simplest means of illustrating the sizes, formations, and prices of the refrigerators in use in this district, I annex an illustrated price-list of the Actien-Gesellschaft-Eiswerke, Hamburg, which is about the most important concern of the kind in Hamburg. Only these seven sizes are constantly manufactured and kept in stock, but orders for larger ones are executed to suit the purchasers. There are only three or four firms in this city who store and deal in ice. The ice is cut in canals and small lakes near the city and stored in ice-houses very similar to those in use in the United States. The quality, however, is poor, owing to the filthiness of the water; the ice is consequently fit only for cooling purposes. The price per 100 pounds varies from 12 to 15 cents; after mild winters, however, it has commanded as high as 18 cents.

REFRIGERATORS IN GENERAL USE IN HAMBURG.

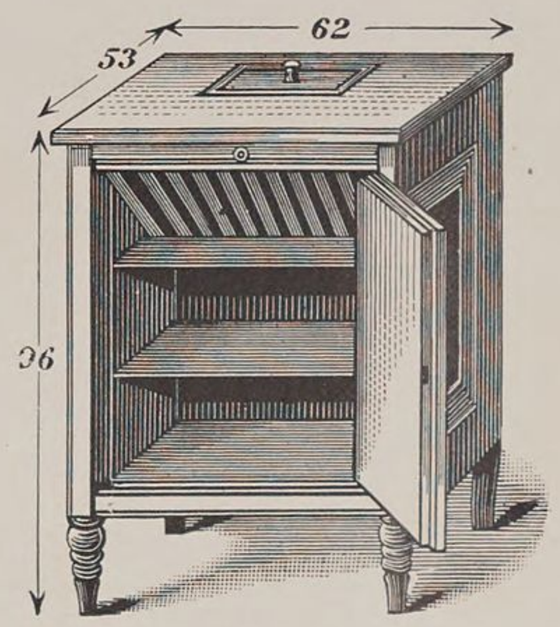
PRICE-CURRENT.



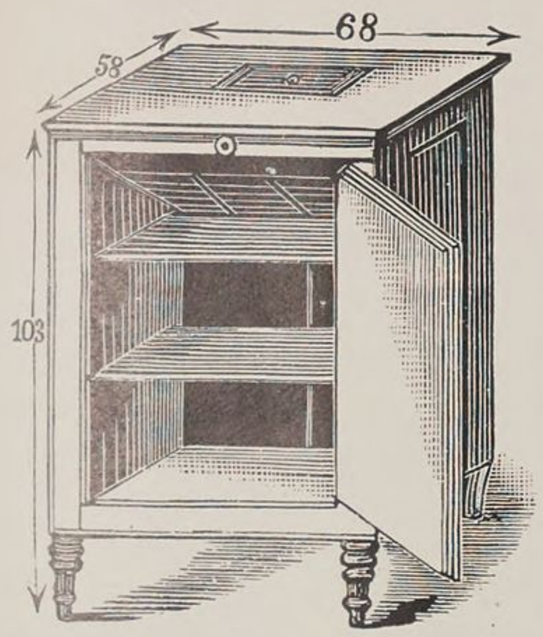
No. 1.—Price, $6.67.



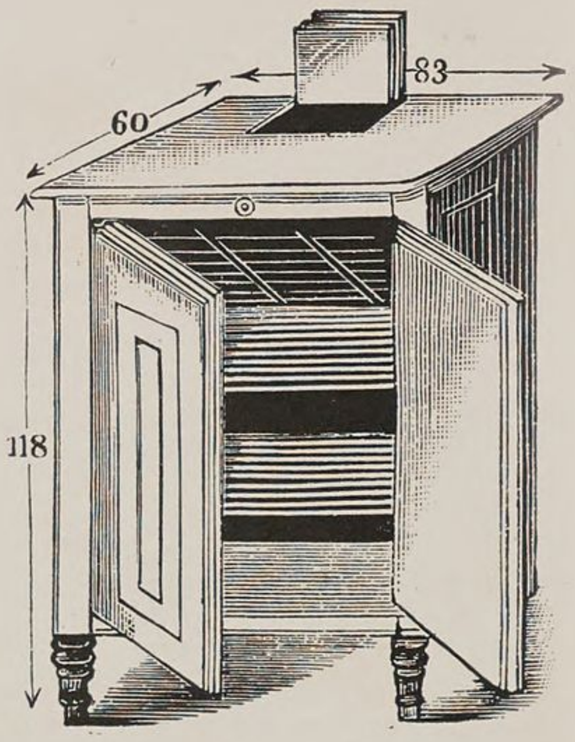
No. 2.—Price, $8.93.



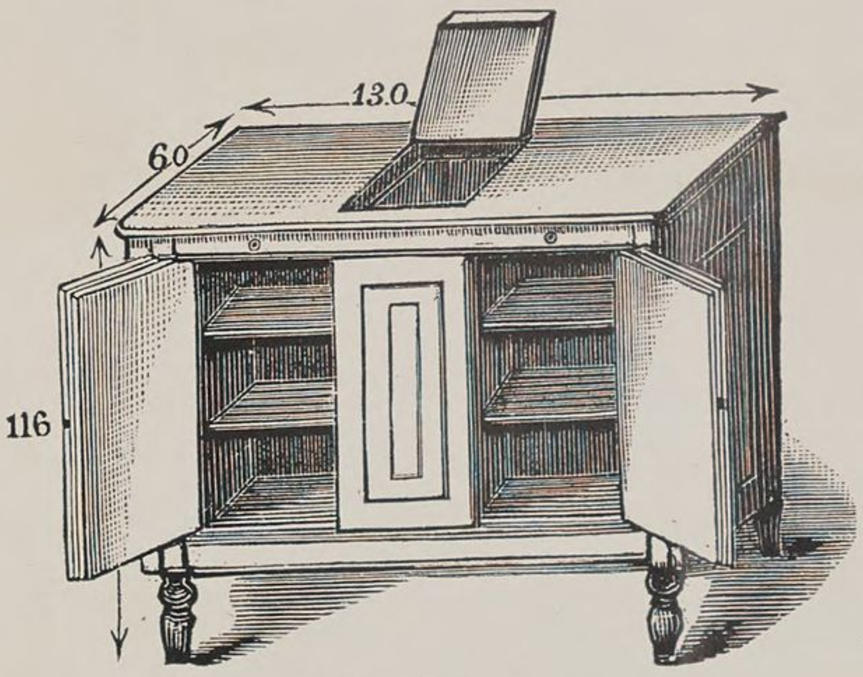
No. 3.—Price, $10.71.



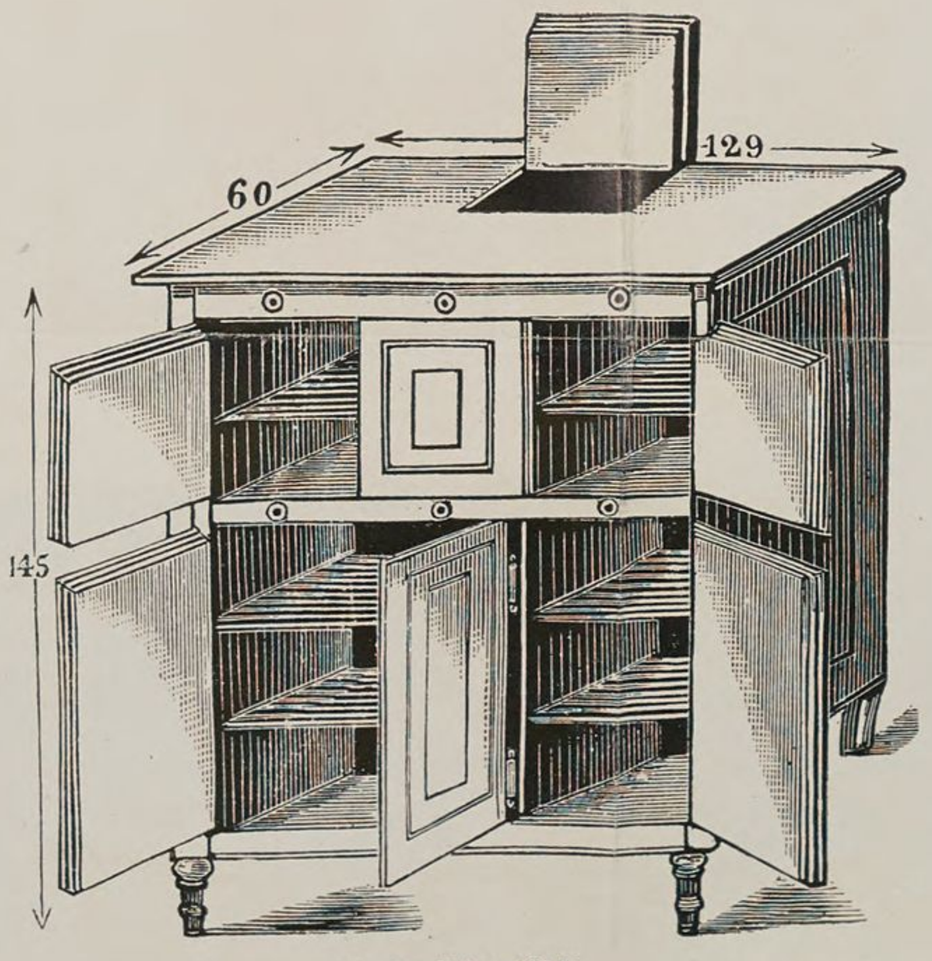
No. 4.—Price, $11.90.



No. 5.—Price, $15.47.



No. 6.—Price, $22.51.



No. 8.—Price, $32.13.

ld winters, however, it has commanded as high as 18 cents.

The consumption of ice in the city of Hamburg alone, exclusive of the breweries, slaughter-houses, etc., is about 100,000 tons per annum.

As the best means of introducing refrigerators into this district I should suggest a direct communication with the dealers through the aid of our consular officers.

CHAS. F. JOHNSON,
Consul.

UNITED STATES CONSULATE,
Hamburg, February 28, 1890.

[Translation.]

HAMBURG CHAMBER OF INDUSTRY,
Hamburg, February 24, 1890.

His Honor Senator Dr. BURCHARD, etc.,
Present:

The Chamber of Industry has the honor to comply with the request of January 17, received January 20, 1890.

There can be no doubt that ice-boxes, and not other cooling-apparatus, are meant by the term "refrigerators," as it appears defined in the two passages following interrogatories 1–5 of the inclosure which is returned.

Refrigerators are extensively used here; they are of various sizes and construction, and the prices also vary greatly according to quality.

As far as we know there are no manufactories in Hamburg which build refrigerators on a large scale. Some few are manufactured at Ottensen (near Hamburg), but otherwise they are imported from districts with cheaper lumber and labor-prices.

Respectfully,

THE CHAMBER OF INDUSTRY,
BAUR, *President.*

MAYENCE.

REPORT BY COMMERCIAL AGENT SMITH.

Refrigerators are used to a considerable extent in this consular district by people of the upper and middle classes, and they are coming more and more into general use all the time. They will soon be found in every family of fair standing.

So far as I have been able to ascertain, no peculiar features of construction are called for by the public. The chief requirement is that they should be cheap, and they are sold at remarkably low figures—prices with which, I think, the Americans could not possibly compete with any satisfaction. Price always plays a very important rôle with the German, and is, to a large extent, the determining factor with him in the purchase of many articles. The manner of construction of the different kinds of refrigerators chiefly in the German market will be shown by the descriptive catalogues herewith transmitted. Slight improvements of various kinds in construction are constantly taking place.

The refrigerators sold by the leading firms here at Mayence and at Wiesbaden, a city near by of some 55,000 inhabitants, are all of German make, and are manufactured in Dresden, Gaggenau, near Rastatt, in Baden, at Düsseldorf, at Aschaffenburg, and at Cassel. These are said to be the leading places of manufacture in Germany. There are no

others of any account, I have been told, except, may be, at Chemnitz, where handsome and expensive articles, not much purchased by the general public, are manufactured.

The best refrigerators now made in Germany, a large dealer informs me, are probably those manufactured at Gaggenau, in Baden. They are constructed upon a new principle and have been in the market only two or three years. Being the best, they are also the dearest, but not much dearer than other makes.

The Eschebach & Hausner refrigerator (Dresden) are lined with zinc and the spaces between the sides are filled in with wheat chaff, I am told. All of their refrigerators, except the catalogue numbers 1701, 1702, 1703, 1704, 1705, 1706, and 1735 are made of oak, with the inlaid parts varnished to resemble maple, while these numbers are of old oak, with the inlaid pieces painted to look like English walnut; that is, like light walnut. The refrigerators Nos. 1711 to 1714 have a good lock, with a nicely nickel-plated brass escutcheon and key, while all the others have a double lock with a handle, the key, escutcheon, and handle being of brass, nicely nickel-plated. The refrigerators 1701 to 1719 and 1735 have each a divisible grate, so that but half of it need be taken out whenever desired. All the sizes 1701 to 1722 and 1735 are provided with removable ice chests or boxes, to make the cleaning of them easy. The stop-cocks for letting the water off are all of nicely nickel-plated brass. The tops of the refrigerators present a smooth surface when the lids, by which the ice is let into the refrigerators, are down, as the handles to them are made to fit into them so as to make a flat surface. The upper outer surface of the lids is of iron plate. Provision is made for the carriage of the sweat-water that forms on the ice-boxes into a receptacle therefor, and thus prevent it from collecting on the bottom of the compartment for food. The refrigerators 1701 to 1722 and 1735 are sold with pinked ice-boxes, to accelerate the refrigerating. An enameled ice-water cooler can be had with all the refrigerators for a dollar or two extra, and a filter also to go with it. The ice is put into the refrigerators at the top into a compartment that reaches from the top to the bottom of the refrigerator. The cooling is effected from the sides of these compartments.

On Eschebach & Haussner's refrigerators the trade are given 20 per cent. discount on the catalogue prices. The packing and freight are borne by the trade.

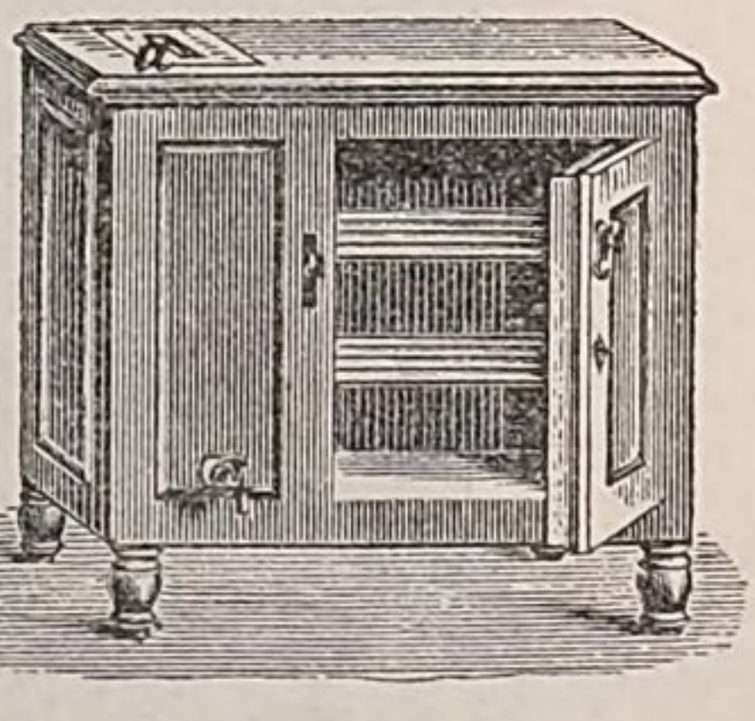
One dealer selling Eschebach & Haussner's refrigerators informed me that he sells most of No. 1713 on the catalogue, which is sold at $8.56 retail, without ice-water cooler. The wholesale price is $7.14.

The refrigerators of the Eisenwerke Gaggenau, in Baden, are constructed upon what is known as the jalousie system; that is, ventilated by means of slats or bars, upon the principle of the Venetian blind. In this refrigerator the cooling is done from the top, which is its leading characteristic and a departure from the established method, I understand. The inventor of it claims that thereby more room is obtained

in the refrigerator with the least waste of ice and lowest degree of temperature with proper circulation of air. The ice-chest or box hangs freely in the upper part of the refrigerator. It is made with slats. The cold air streams out between the slats and naturally passes down into the refrigerator, while the arising warm air becomes commingled with the cold streams coming from above and brings about a regular circulation of air. The water, as it condenses in the ice-box, drops from slat to slat, collects at the bottom, and runs through a pipe into a reservoir, where it can be used to cool liquids, etc. The ventilation is claimed to be superior to that in other refrigerators. Hitherto it has been effected through the door in front and the back, which the inventor of the Gaggenau refrigerators claims has been only to bring in warm air without actually airing the refrigerator. The bad air he gets out by means of a pipe through which it ascends. Through this arrangement the refrigerator is freed of unpleasant odors and the melting of the ice materially retarded by the exclusion of all warm air. The filling is of slag-hair.

Of Schmidt & Keerl's refrigerators I have only a descriptive sheet, with cuts of the refrigerators and their sizes upon it. Their wholesale prices have been given me by a dealer. On these prices they allow 10 per cent. off, but the packing and freight equalizes this. Three months' time is granted, with a discount of 1½ per cent. for cash payments made within two weeks. The refrigerator that sells best is No. 3, sold at about $9.50 retail. Their refrigerators are constructed on the jalousie system, are lined with strong zinc, and the spaces between the sides are filled in with slag-hair. They all have removable ice-boxes, permitting easy cleansing. Waste water is carried off by a pipe into a basin that goes under the refrigerator, when there is a superfluity of water through neglect to let it off by the regular stop-cock. Their refrigerators can all be had either plainly painted or nicely varnished. The refrigerating is done from the sides of the compartments or boxes containing the ice.

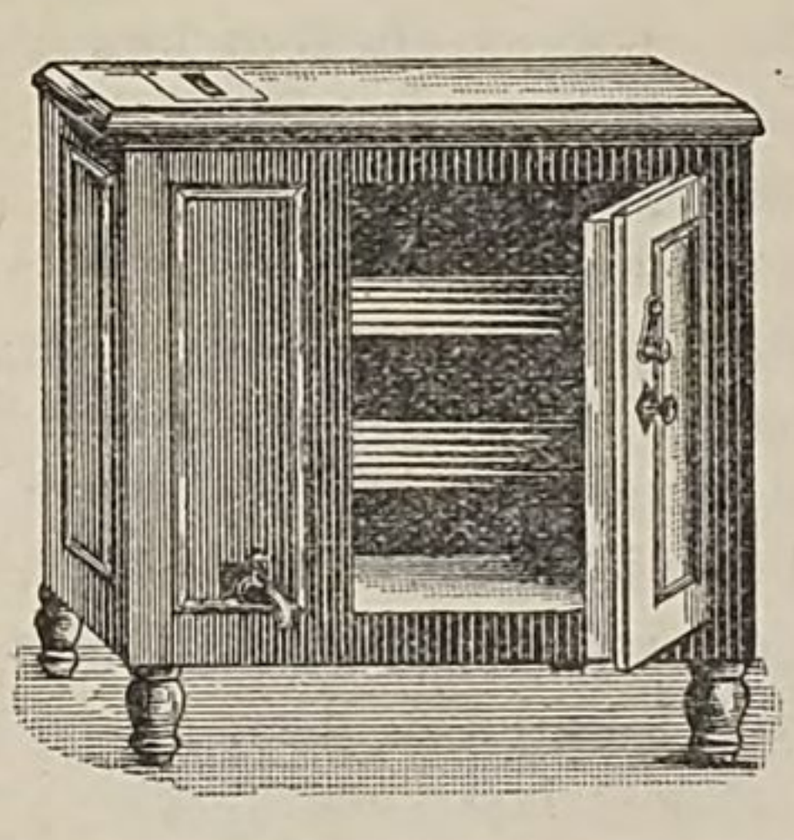
No. 2.—Height, $30\frac{3}{10}$ inches; length, $26\frac{3}{10}$ inches; depth, 19 inches; weight, 79 pounds; price, *$6.50.



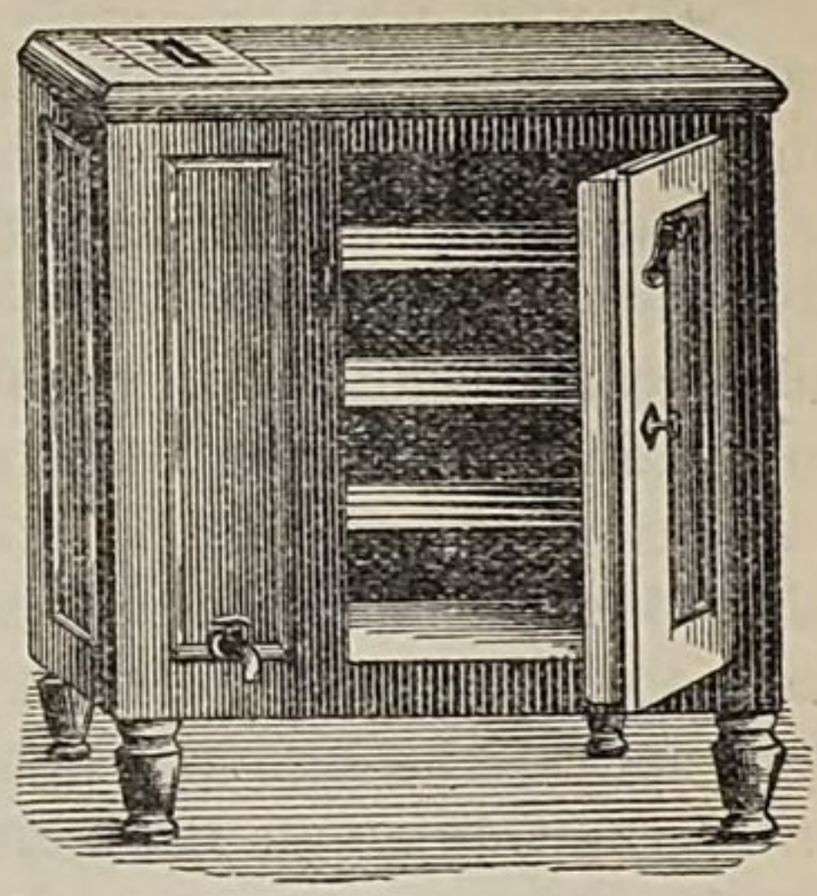
No. 3.—Height, $31\frac{1}{2}$ inches; length, $31\frac{1}{2}$ inches; depth, $19\frac{6}{10}$ inches; weight, 90 pounds; price, $8.50.

a This lid raises and the ice goes in here, from top to bottom.

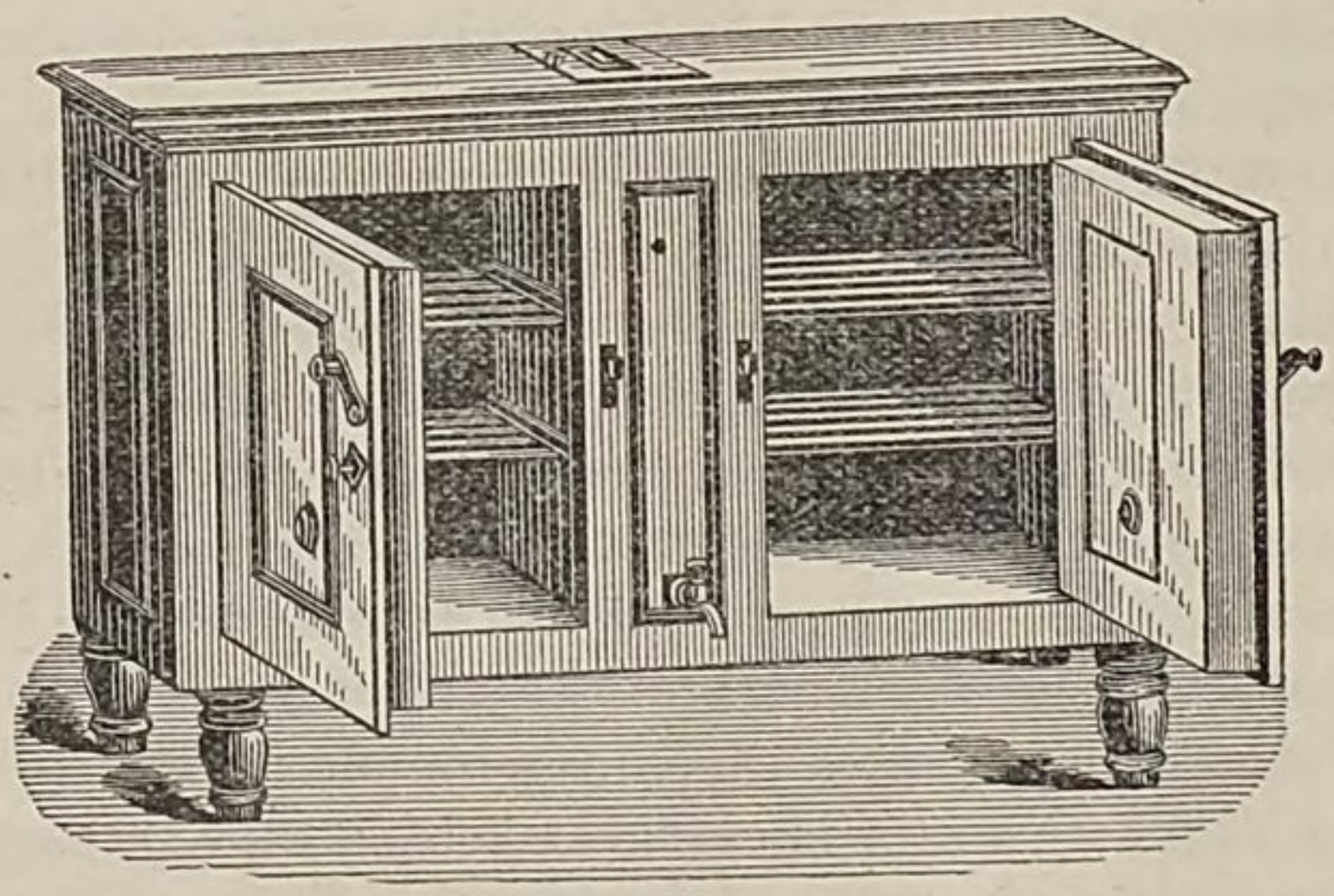
* The prices are all for varnished refrigerators.



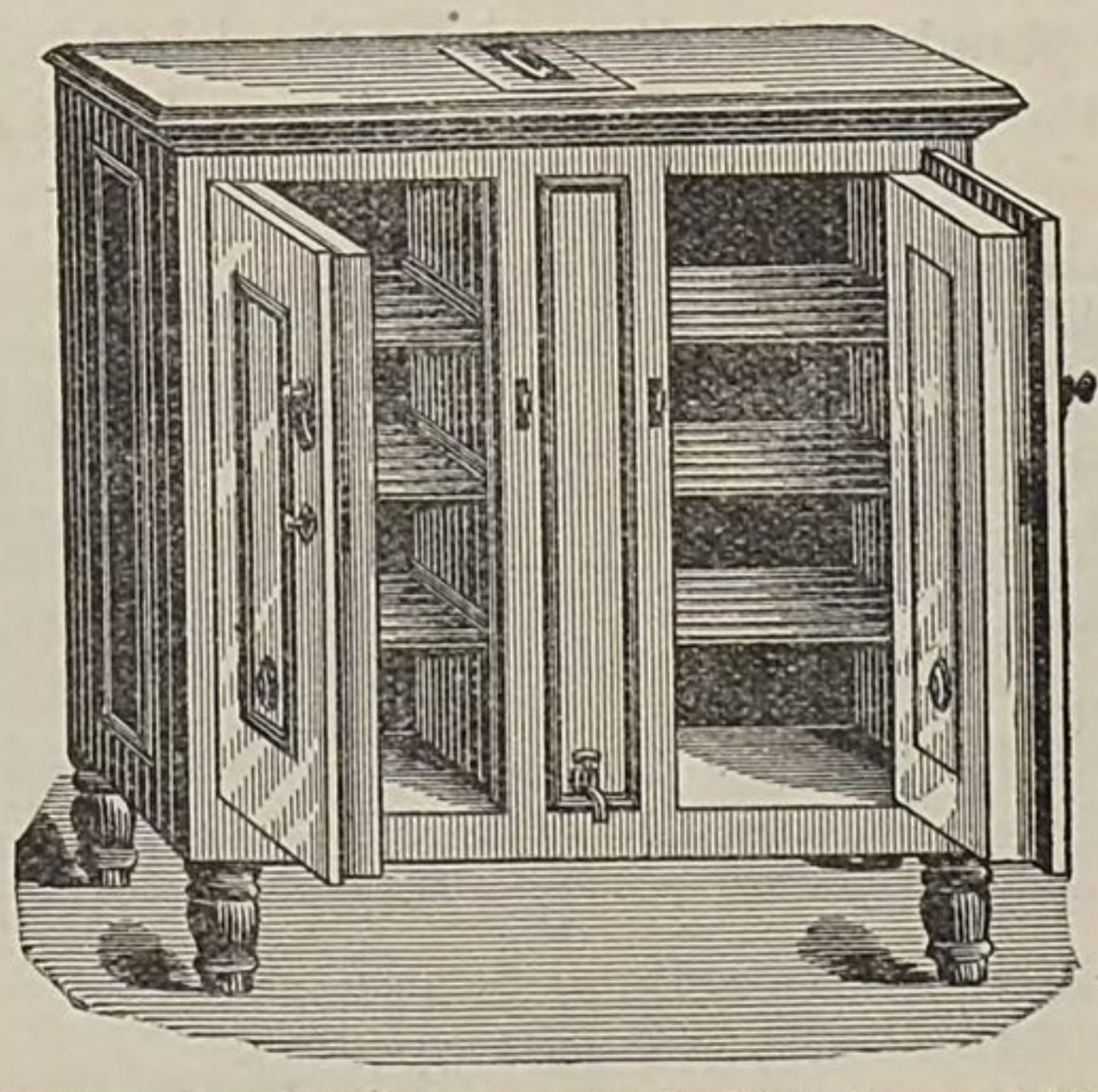
No. 5.—Height, $35\frac{1}{3}$ inches; length, $32\frac{2}{10}$ inches; depth, $20\frac{1}{3}$ inches; weight, 116 pounds; price, $10.25.



No. 6.—Height, $30\frac{3}{10}$ inches; length, $34\frac{6}{10}$ inches. depth, $22\frac{8}{10}$ inches; weight, 154 pounds; price, $12.

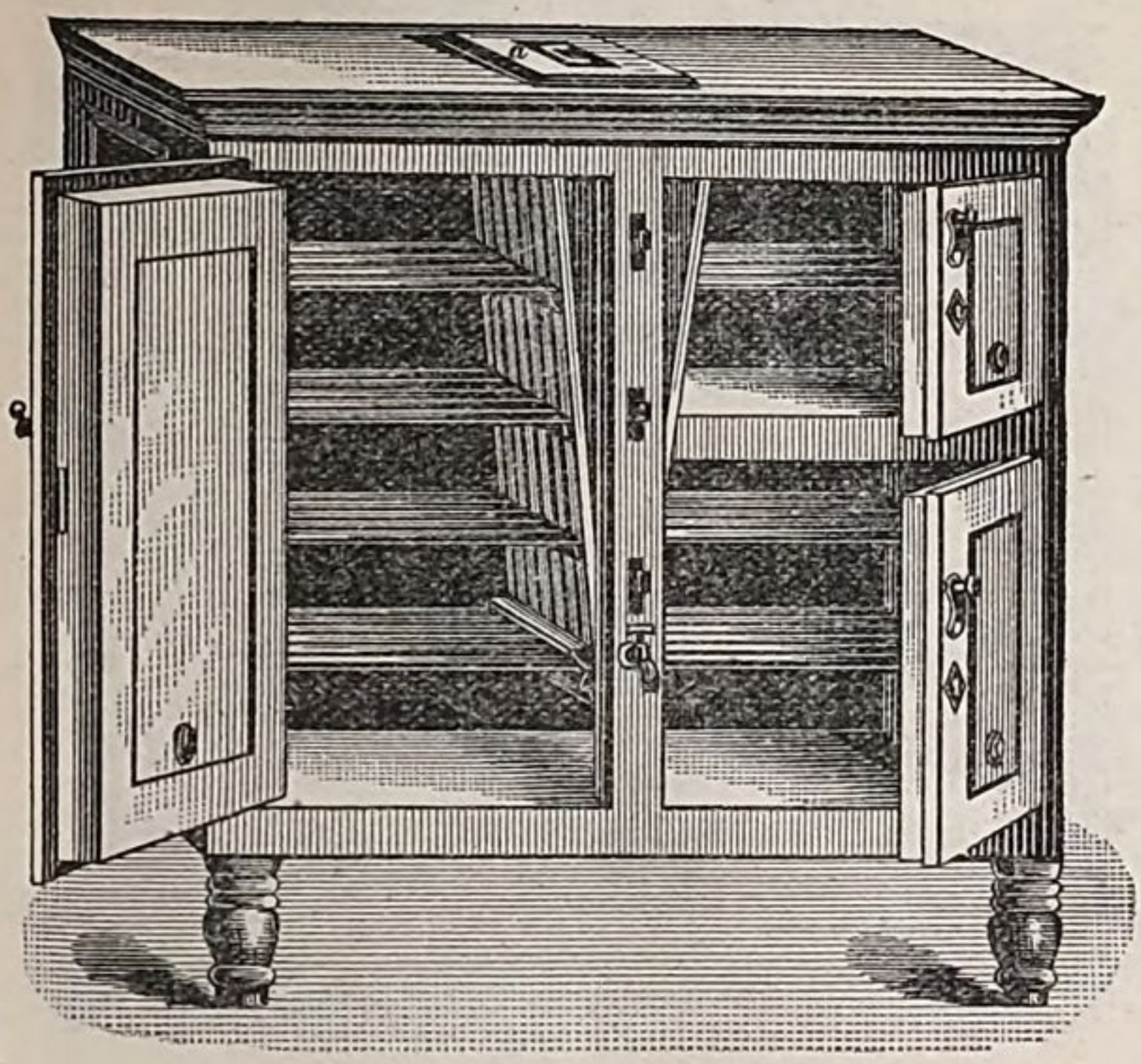


No. 7 a.—Height, $39\frac{3}{10}$ inches; length, $45\frac{3}{10}$ inches; depth, $23\frac{6}{10}$ inches; weight, 215 pounds; price, $16.66.

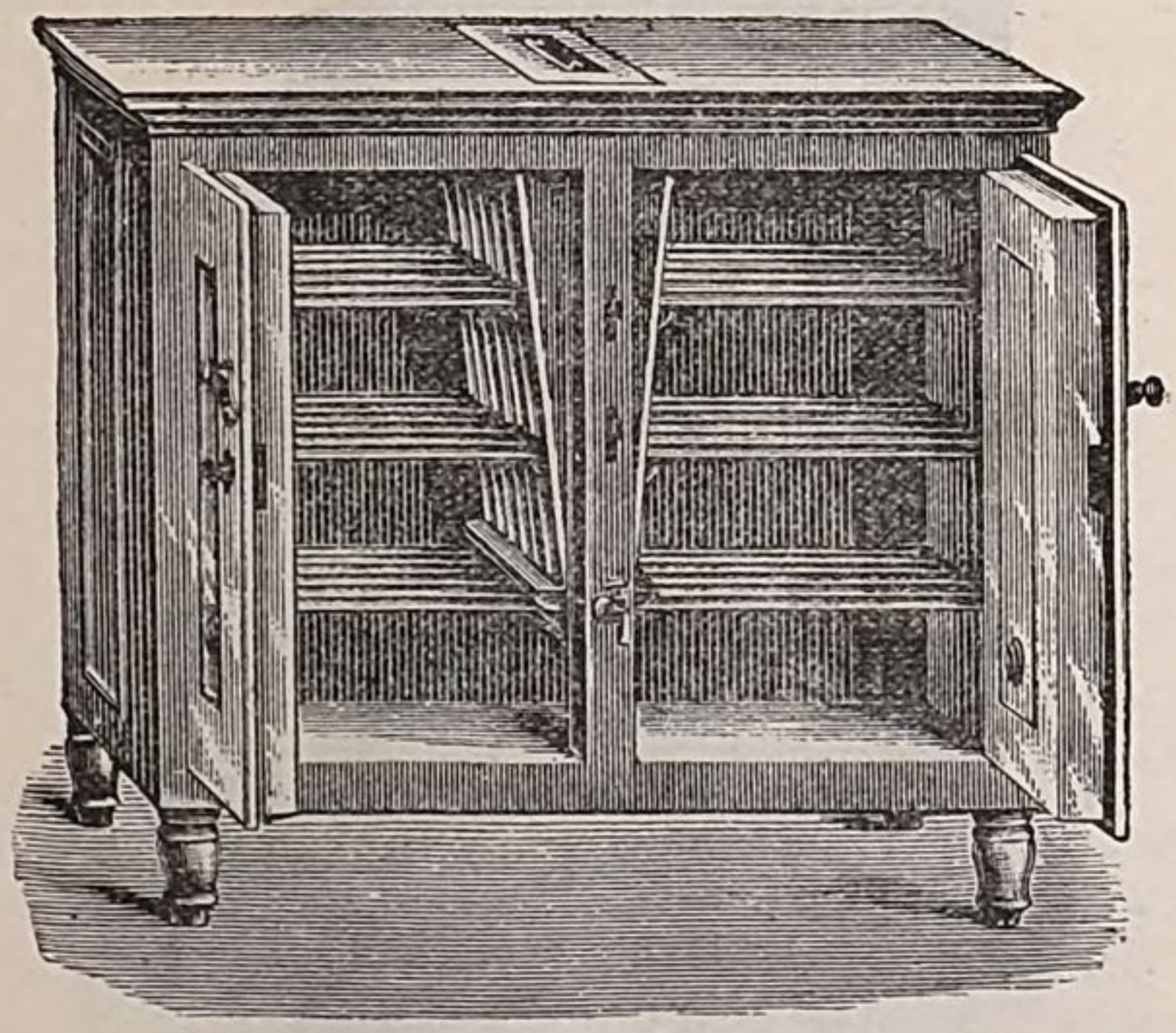


No. 7 b.—Height, 50 inches; length, $45\frac{3}{10}$ inches; depth, $26\frac{1}{2}$ inches; weight, 286 pounds; price, $22.

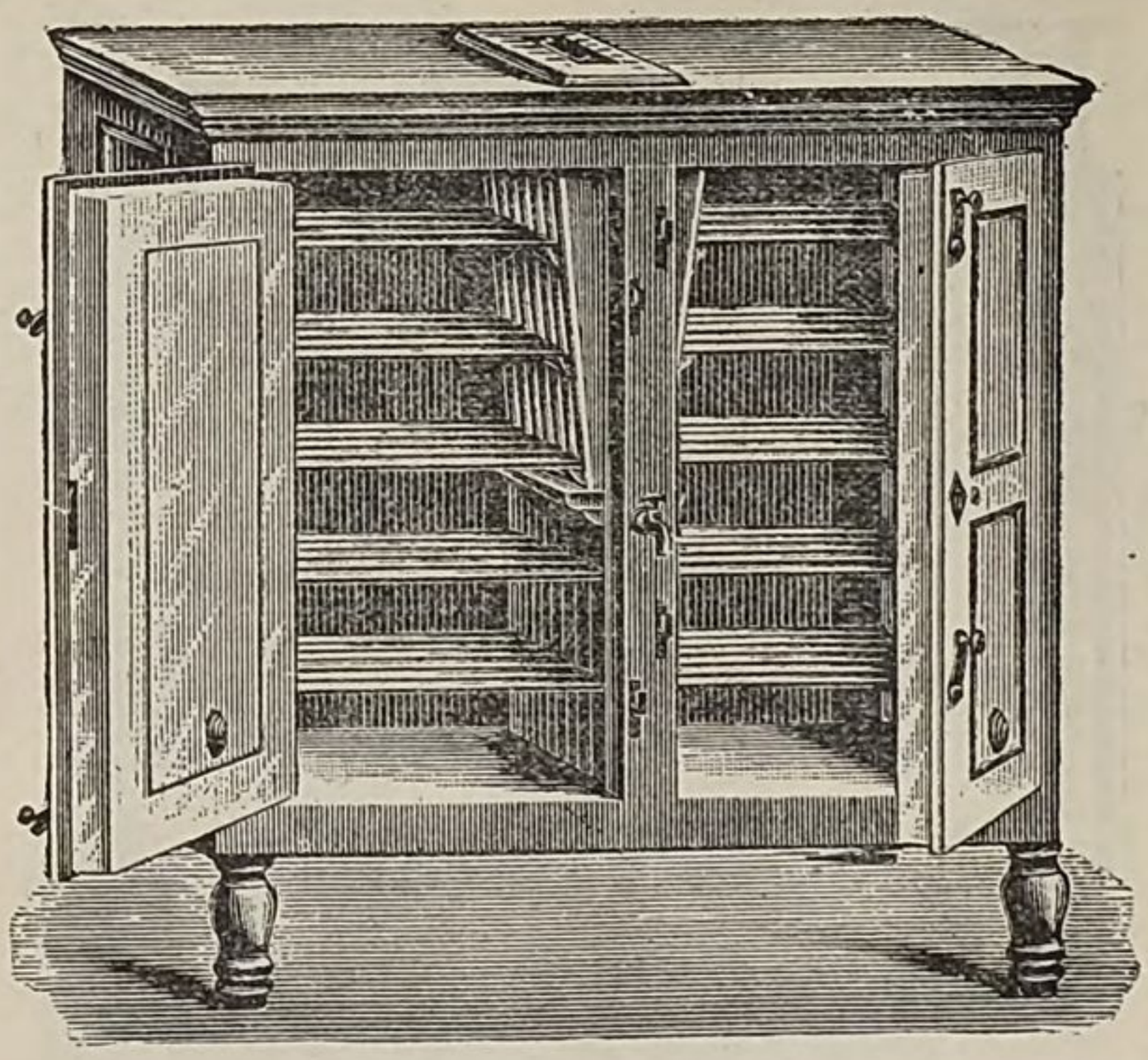
a Ice receiver extending from top to bottom of refrigerator.



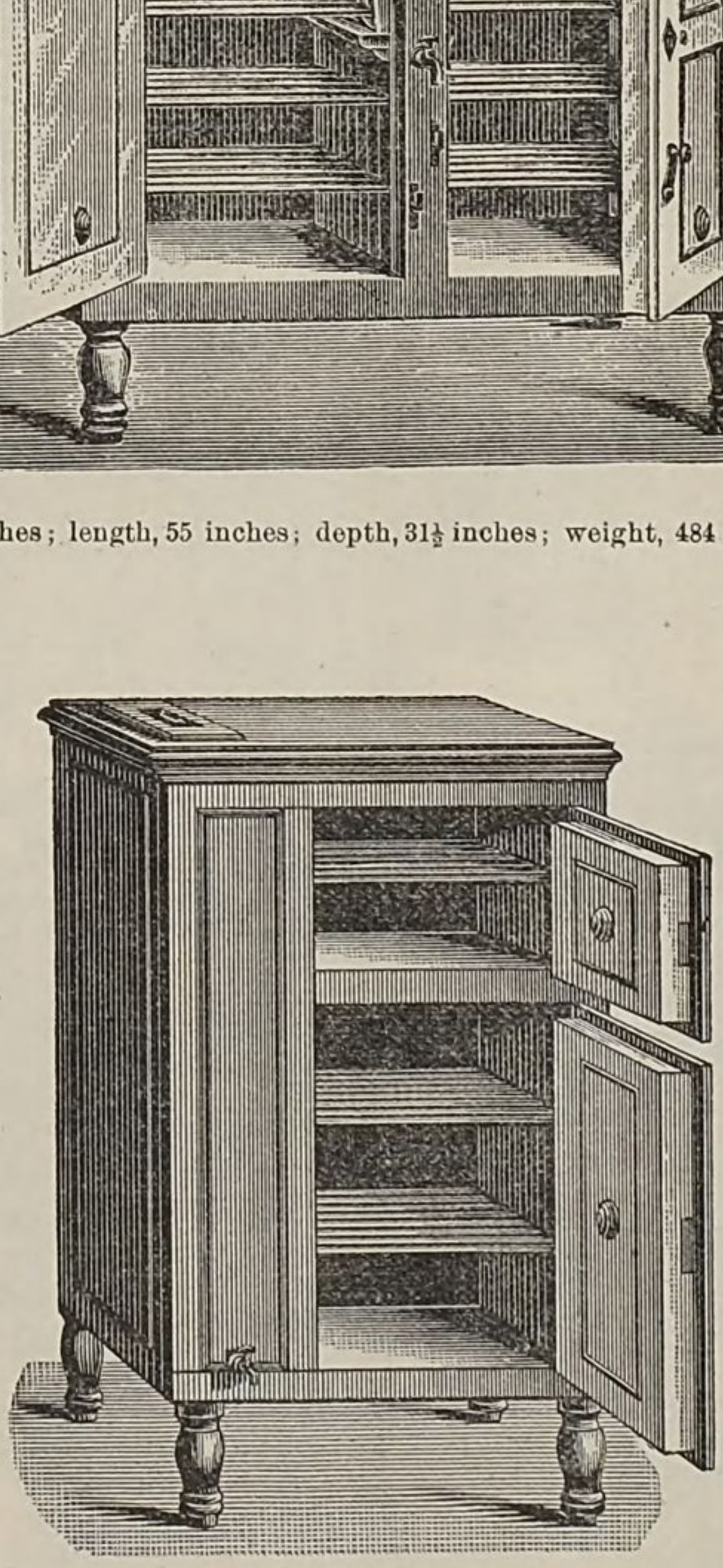
No. 17. (For a store).—Height 59 inches; length, 55 inches; depth, 31½ inches; weight, 484 pounds; price, $29.75.



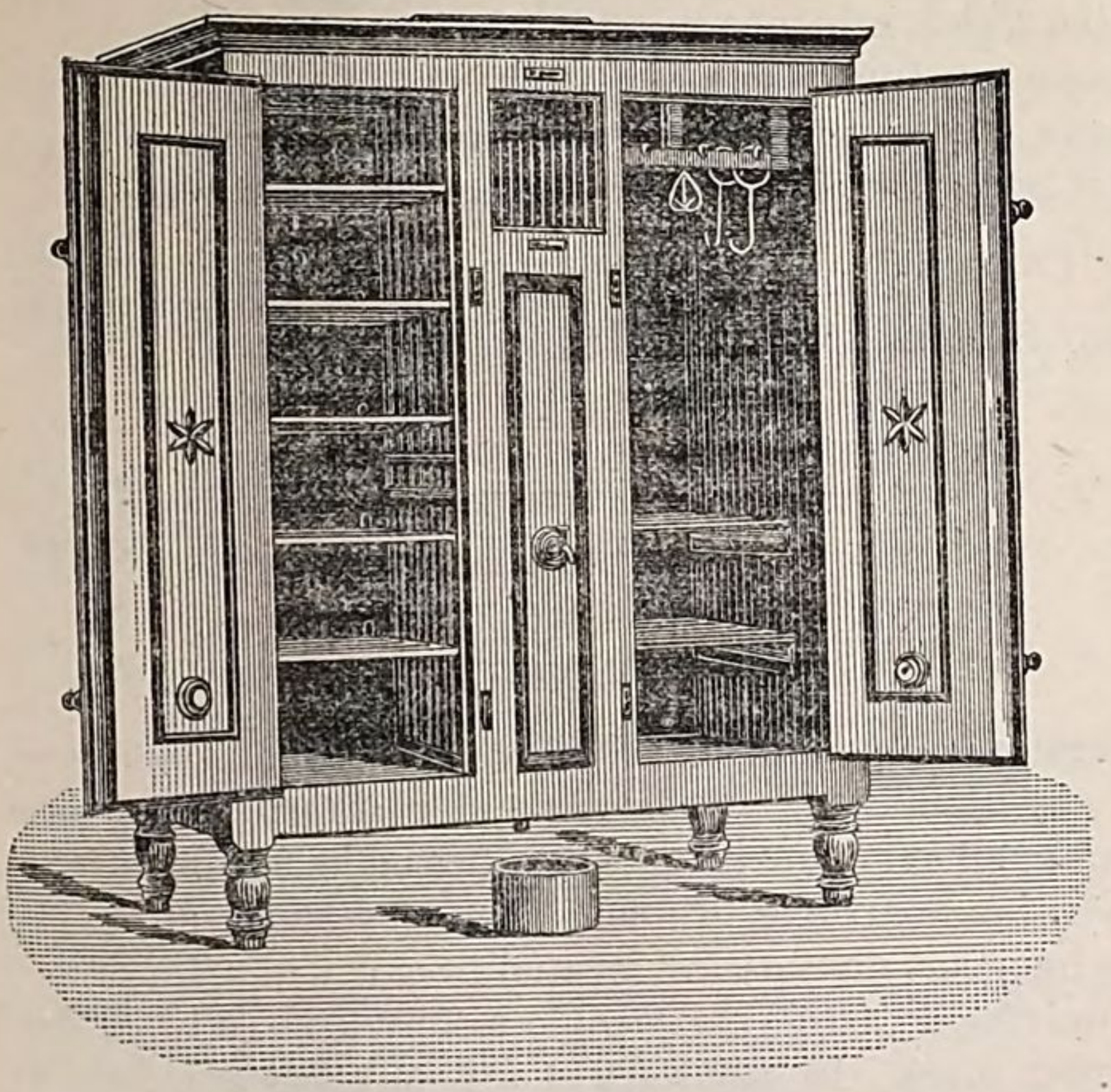
No. 16. To hold food and wine for a store.—Height, 51 $^{1}/_{16}$ inches; length, 55 inches; depth, 31½ inches; weight, 455 pounds; price, $25.



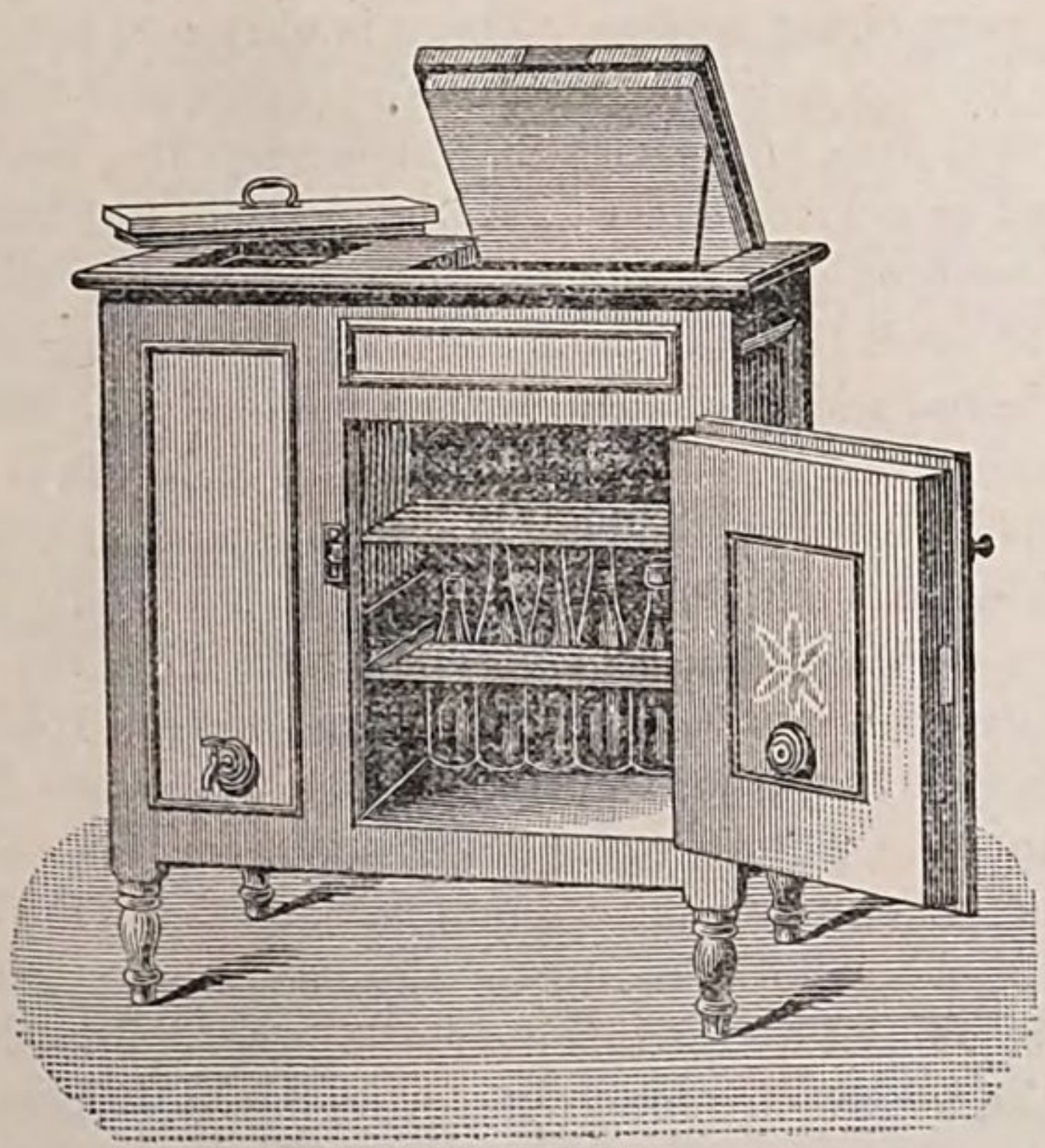
No. 27.—Height, 59 inches; length, 55 inches; depth, 31½ inches; weight, 484 pounds; price, $32.13.



No. 19.—Height, 62$\frac{2}{16}$ inches; length, 35⅓ inches; depth, 26½ inches; weight, 286 pounds; price, $20.25.



No. 36 (for butchers and hotels).—Height, $62\frac{3}{10}$ inches; length, 49 inches; depth, $27\frac{1}{2}$ inches; weight, 528 pounds; price, $38.



No. 9.—Height, $43\frac{3}{10}$ inches; length, $34\frac{6}{10}$ inches; depth, $22\frac{8}{10}$ inches; weight, 176 pounds; price, $15.23.

There are two or three more cuts of refrigerators for large butchers and hotels, which I do not think it necessary to give.

In conclusion, I have to say that the catalogues and prices furnished by me have been given me by dealers, and that the trade expect to make a profit of 20 to 30 per cent. on refrigerators sold by them.

JAMES H. SMITH,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Mayence, March 3, 1890.

MUNICH.

REPORT BY CONSUL MEALEY.

Refrigerators are used, but very few; outside of the city of Munich you may say not at all. The hotels and restaurants use them, but not all of them, and very few private families make use of them. The business in perishable articles of food is done by small stores or shops, of which an immense number are located in every quarter of the city, and it is the universal custom for people to buy from day to day such articles as they need. In fact very many buy twice a day; that is, for each meal.

The only thing, or the main thing, asked for by would-be purchasers of refrigerators here is that they be cheap, and the endeavor of the maker is to supply a very cheap article. There is only one peculiar feature to be noted: the ice-box is made to receive a rectangular block of artificial ice about two feet long and about five inches square, the ice being first placed in a sort of a wire cage which just fits and has handles to facilitate its being lowered and raised from the ice box in the refrigerator.

I can learn of none that are sold here which are manufactured anywhere except here in Munich, and by the persons who sell them. I can only learn of those people who sell them here in Munich.

Both natural ice and artificial ice are used, the former by butchers, beer breweries, and large consumers, the latter mostly by private consumers, the artificial ice being cleaner. But compared with the use of ice in the United States there is very little ice used here. It is a rare thing for a private family to use ice in any manner, and when they do it is a very small quantity. There are several reasons for this. Suffice it to say that the weather in summer is so much cooler than in the United States that there is not the same demand for the use of ice; then the custom of buying in very small quantities everything needed in the house, and the cellars of the houses are made use of by house-keepers for the keeping of all articles that may be perishable. The price for artificial ice, delivered in the refrigerator, is about 75 cents per 100 pounds; the price of natural ice about 70 cents per 100 pounds. The ice is delivered to private families twice a week in summer and about once a week in

spring and fall. Some restaurants and cafés have refrigerators for keeping the barrel of beer they are drawing from, but they are few as the beer is considered to be somewhat spoiled by being kept too cold by means of ice. I very much doubt if the sale of refrigerators could by any possible means be much increased here, as there is very little demand for them, and, as I have stated above, the climate does not make their use very pressing or necessary.

EDWARD W. MEALEY,
Consul.

UNITED STATES CONSULATE,
Munich, February 4, 1890.

STETTIN.

REPORT BY CONSUL FAY.

The common house ice-chest is extensively in use and is sold at a very low price in Stettin.

One may purchase an ice-chest sufficiently large for family use for $5. They are very conveniently arranged and well made.

As the duty on refrigerators of any sort is very high, about $1.25 per 100 pounds, I imagine it would be hard to compete with the German manufacturers in this branch at the prices at which they are sold in Stettin.

The larger class of refrigerators, such as are in use by provision dealers and butchers in America, are not to be seen here.

Ice being so very plentiful and cheap, such dealers fill their cellars therewith in winter and preserve the meats, etc., therein during the hot season. Ice is retailed at one-eighth to one-quarter cent per pound during the summer season.

ANDREW F. FAY,
Consul.

UNITED STATES CONSULATE,
Stettin, February 9, 1890.

HOLLAND.

AMSTERDAM.

REPORT BY CONSUL ECKSTEIN.

Refrigerators are used in Holland in nearly all hotels, restaurants, cafés, butcher shops, hospitals, and in other public institutions, but only to a limited extent in private families or boarding-houses.

By the general public, refrigerators are regarded more in the light of an article of luxury than of necessity so far as their use is concerned in private houses.

A variety of circumstances obviate the necessity of their use, chief amongst which are that intensely hot weather rarely prevails many days together during any summer, whilst there always exists more or less humidity or moisture in the atmosphere, which keeps articles of food, such as meat, fish, vegetables, etc., in a sound condition for such time as such supplies are ordinarily provided for.

Besides there exist in this country, in the large cities, smaller towns, and even in the country, great facilities for procuring all sorts of perishable articles conveniently for daily use.

I am assured no particular or special features are required in the construction of refrigerators for use in this country for either preserving food or liquids. In answer to this point, more detailed information is conveyed in reply to the fourth question.

Most of the refrigerators used in Holland are imported from Aschaffenburg, Bavaria, and other places in Germany, and some are imported from England and France.

Formerly they were an article of domestic production to a certain extent, but their manufacture in this country has stopped, from all I can learn.

The greater part of the ice used in this country consists of sweet-water or artificial ice. It is manufactured by the principal breweries for their own consumption as well as for sale.

There are also two large ice companies, one operating in natural ice and the other manufacturing the artificial article.

Natural ice is secured here by being cut out of the river Amstel, in ever varying quantities and qualities from year to year, according as the season is mild or severe. It is also imported in large quantities from Norway.

The price per 100 pounds is about 0.50 florin (20 cents), and in large quantities, by the ton of 2,200 pounds, it can now be contracted for and delivered at 8 to 9 florins ($3.20 to $3.60) per ton.

As is represented to me, it would be advisable for American manufacturers of refrigerators who desire to introduce into this country successfully the product of their manufacture, and with a prospect of finding a permanent market for it here, to consign to some trustworthy person or persons, as agents in this city and in a few of the other large cities in this country, small assortments of refrigerators of different styles and sizes and varying prices.

Having secured energetic and pushing agents for the introduction and sale of the article the demand for them may spring up if the prices of our manufacturers can compete with those at which the product of other countries is selling here.

As such an agent I can unhesitatingly mention and recommend the firm of Fred Stieltyes & Co., at Amsterdam.

I would also mention here the firm names of the principal retail dealers in refrigerators at Amsterdam, with whom some of our manufacturers of refrigerators may find it to their advantage or desirable to correspond or make offers to.

They are: E. B. Vieth, F. L. A. de Gruyter, L. Dake & Son, Widow Kirchmann & Co., J. Peignat & Co., L. A. C. Victor, Becht & Dyserinck, and J. B. Gorris.

D. ECKSTEIN,
Consul.

UNITED STATES CONSULATE,
Amsterdam, March 28, 1890.

ITALY.

CATANIA.

REPORT BY CONSUL LAMANTIA.

There are no manufactories of any such articles, and the American refrigerator is entirely unknown in this section of country.

I have also made inquiries of the several hotels and restaurant proprietors on the subject, who told me that they use no refrigerators in their establishments, as they have no use for them, for the reason that during the summer season they buy sufficient provisions to do for the daily consumption.

Mr. M. Patriarca, however, an importer and wholesale and retail dealer in national and foreign goods, of this city, informs me that he imports small refrigerators from Germany, the size being 20 inches wide by 24 long and 30 high, which he sells for 45 lires each, but says that there is a very little sale of them, on account of such a high price; consequently it is a hard matter in this section of country to dispose of such articles at more that 30 lires ($8.68) each. If, however, he adds, small American refrigerators of said size, economically constructed, could be laid in this market for 20 or 25 lires ($3.86 to $4.83) each, he thinks at such a price their introduction, extension, and sale could be easily secured.

As far as ice is concerned, there are two ice factories in this city, supplying the wants of the people, and the same is sold at 9 lires per 100 kilos.

VINCENT LAMANTIA,
Consul.

UNITED STATES CONSULATE,
Catania, February 15, 1890.

FLORENCE.

REPORT BY CONSUL DILLER.

Refrigerators are used in this district by the leading hotels, pensions, coffee, and beer houses, and by a few of the prominent residents and clubs.

No peculiar features are required in their construction. Many of them are of the most primitive construction, being merely an ordinary box, with a compartment for ice, not lined, with perforated bottom. The better kinds used are generally poor imitations of the American or

English styles, and are manufactured in Milan and Germany. The sizes and formation are similar to the above, with the exception that, instead of wood, zinc or tin is used as the outside covering, and the non-conducting space between the outside and inside lining is greatly contracted, thus deteriorating from their value as preservatives. The imitation American refrigerators, in three sizes, are sold at $9, $17, and $27 respectively, and the English, in the form of benches, in two sizes, at $25 and $30.

The ice used in refrigerators in this district comes from the Appenines, is of poor and porous quality, and is sold at about 20 cents per 100 pounds. Pure clear ice for drinking purposes comes from Poretta, on the boundary between Florence and Bologna, and costs about 25 cents per 100 pounds.

The usual way of preserving food and liquids at the present time is by keeping perishable articles in cool cellars or by suspending them in wells.

I am of the opinion that if a cheap form of refrigerator, made of wood, was introduced it might in time be quite generally adopted, but in order to sell it at a low price, the adjuncts, such as lock, knob, hinges, zinc, wire fittings, and castors should be unattached to the wooden case, accompanying the same, however, in a separate package, to be fitted after arrival.

According to the Italian tariff the duty on manufactures of wood averages about $9 per 100 kilos (220.46 pounds), while the duty upon the fittings, such as I have mentioned, would be at least $14 per 100 kilos; and according to the manner of estimating duties in Italy the duty would be levied on the complete machine, as a whole, at the higher rate, while on the contrary, if the fittings were not attached, the duty would be levied on each article separately, according to weight and kind of material. This is an important item to be considered in exporting refrigerators to Italy. It is not the component material of which an article is composed which regulates the duty charged on the article as a whole, but upon any other material which forms a part of it, however small, upon which the duty is greater than that of the component part, if attached to it.

ISAAC R. DILLER,
Consul.

UNITED STATES CONSULATE,
Florence, January 17, 1890.

GENOA.

REPORT BY CONSUL FLETCHER.

Introductory.—It is no exaggeration to state that more refrigerators can be found in any city of 10,000 inhabitants in the United States than in this entire consular district of over 900,000 souls. Further, it is safe to say that no more ice is consumed in the city of Genoa with

its 180,000 inhabitants than in any city of the United States whose population contains not more than 10,000 or 12,000 people. All this, too, in a country with mild winters, warm spring-time and fall, and very hot summers.

Several reasons can be given for this limited demand for refrigerators and ice, a few of which are as follows:

The Italian people do not consider ice necessary at any season in order to enjoy good health or a good appetite; many of them believe ice injures rather than soothes the palate and stomach.

Economy is practiced here to such an extent that fully ninety-seven families out of every one hundred purchase only sufficient food for daily wants. Nothing remains over for the morrow—not even bread or vegetables. Such being the case, the question, "Why are not refrigerators used in the homes of the Genoese more?" is easily answered.

The use of refrigerators in this consular district is very limited.

There is nothing peculiar in the construction of those in use here.

Those now in use were either brought from Germany or England. Of late the Italians have commenced the manufacture of these articles, but on a limited scale.

The sizes, formation, and prices of refrigerators offered for sale here are as follows:

Portable refrigerators.

[All finely polished in varnish and lined with zinc.]

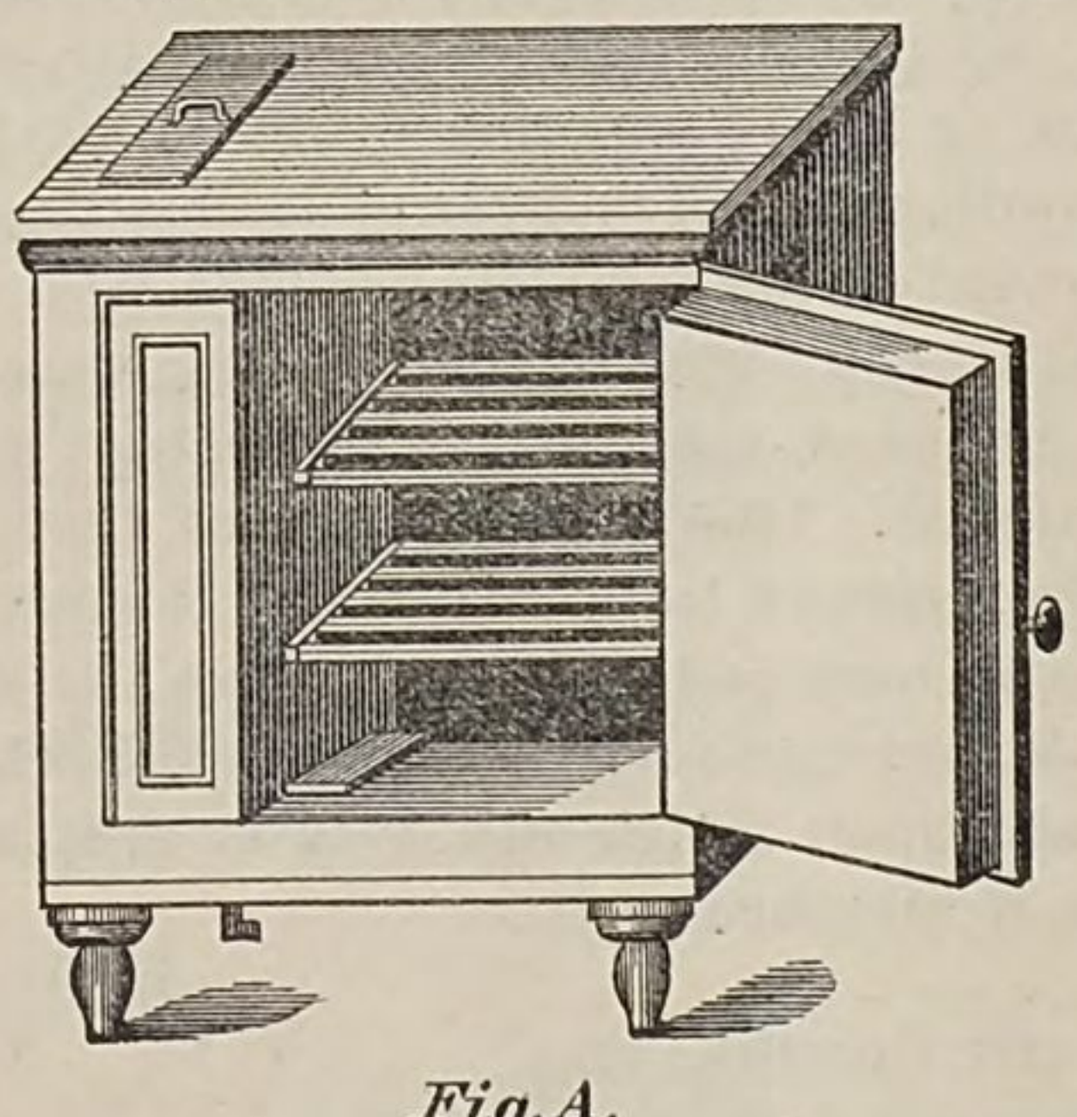


Fig. A.

WITH ONE DOOR.

	Height.		Width.		Depth.		Price.	
							Improved quality.	Common quality.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Feet.*	*Inches.*		
FIG. A.—No. 1	2	5.13454	2	0.01631	1	7.29179	$6.95	$5.60
No. 2	2	6.70938	2	3.55970	1	9.65405	7.70	.....
No. 3	2	7.49680	2	5.13454	1	11.62260	8.90	6.75
No. 4	2	9.85906	2	6.70938	2	0.41002	10.60	8.70

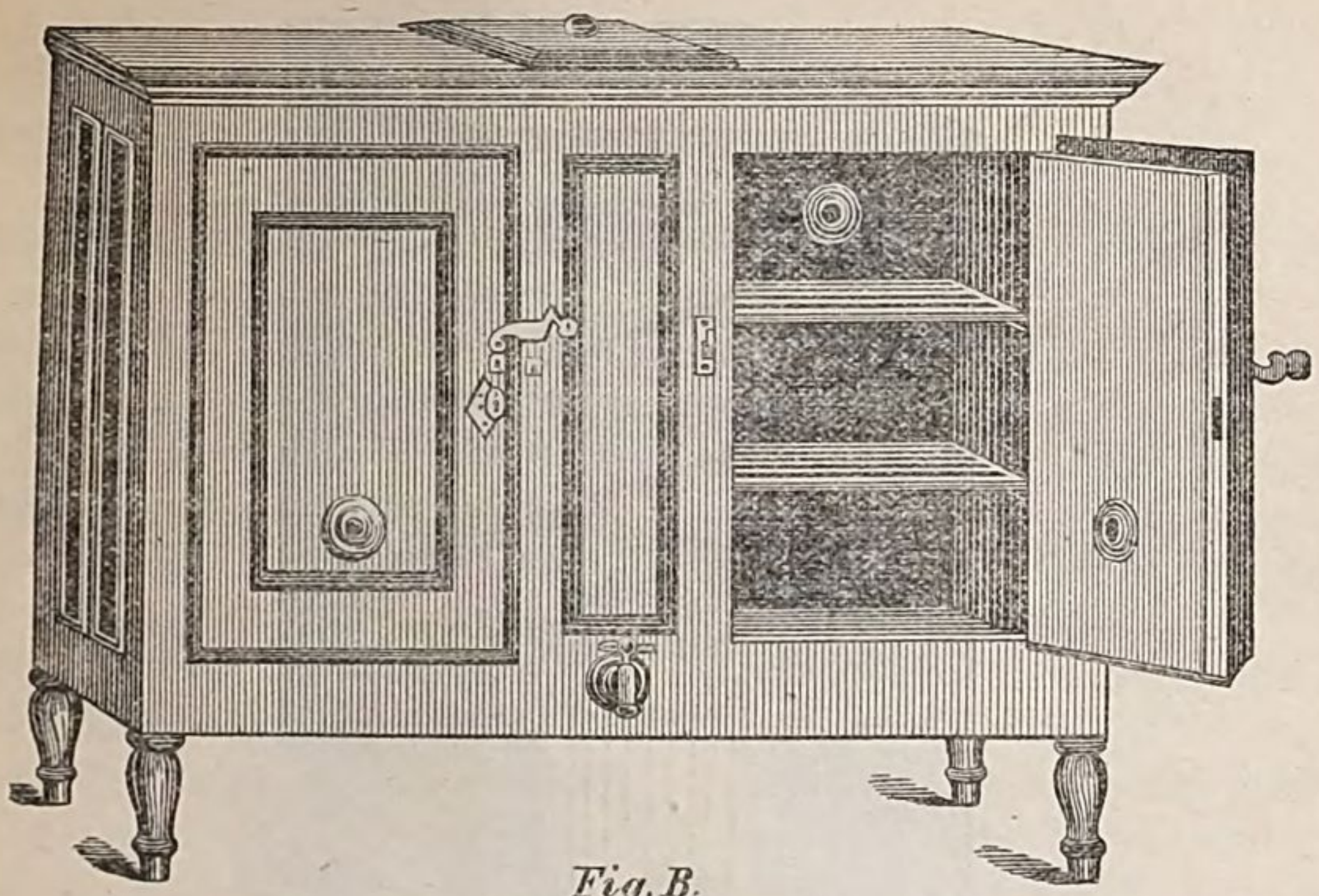


Fig. B.

WITH TWO DOORS.

	Height.		Width.		Depth.		Price of Improved quality.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Feet.*	*Inches.*	
FIG. B.—No. 5	2	5.13454	3	1.40245	1	7.6855	$12.55
No. 6	2	7.49680	3	6.52068	1	11.62260	15.45
No. 7	3	3.37100	3	3.37100	2	0.41002	17.40
No. 8	3	7.30810	3	7.30810	2	1.19744	19.30

Ice fit for table use is taken from the little ponds and streamlets along the mountain sides (along the maritime Alps and Appenines). It is packed in small caves especially prepared for the purpose in the hill sides, near the place where it is harvested. When these caves are nearly filled a covering of leaves from chestnut trees, about two feet in thickness, is placed on top of the ice—nothing more.

Ice is brought into Genoa both by wagons and by rail. A city tax of about 39 cents per 100 pounds is imposed on all ice conveyed within the gates of Genoa. But, notwithstanding this tax, cartage, etc., the article is sold and delivered where ordered at $1 per 100 pounds.

* * * * * * *

Conclusions.—As already stated, the people here purchase day by day the requirements for the day—no more. This habit is also practiced as much as possible at hotels and restaurants, and the consequence is that very few refrigerators can be found even in those places. Some of them have common boxes, in which is placed the ice, and over which are thrown woolen cloths or blankets.

Some of the liquor shops have boxes also, with ice covered as above. But in the 2,000 or more wine shops and liquor stores in this city, it is no strain of imagination to say that you can not find a particle of ice in more than 150, no matter how hot the summers may be.

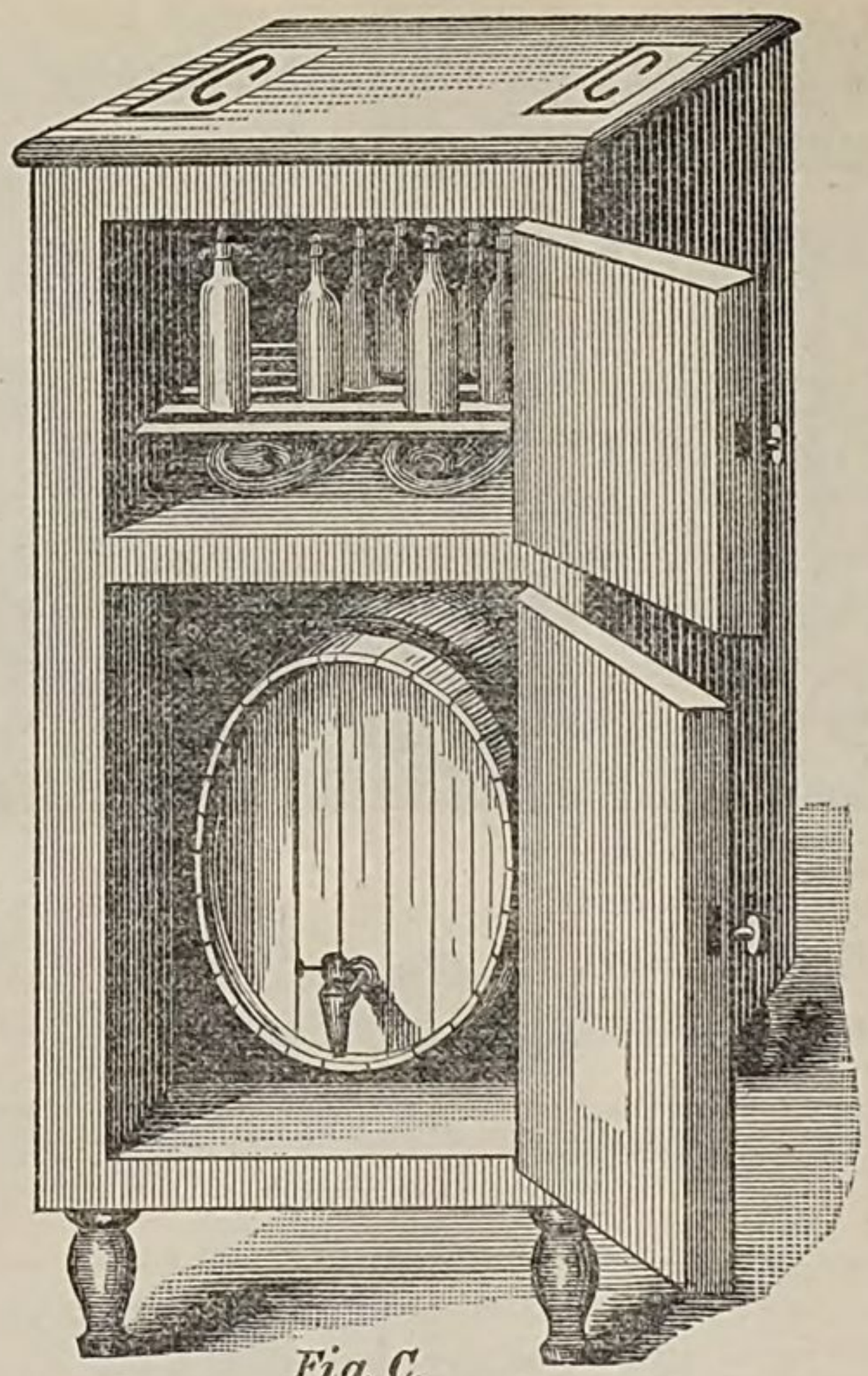


Fig. C.

FIG. C.—Beer Refrigerator, from $23.30 to $48.55.

As far as personal observation goes the people of this district prefer wine, liquor, and even water, each in its normal temperature, much more than when cooled by ice or by any artificial process.

Foreigners, chiefly Americans and English, are the great patrons of ice in this part of the country; but even those people, after a lengthened stay here, adopt the habits of the natives and abstain from the use of this cooling substance.

Managers of hotels, owners of provision stores, of restaurants, liquor shops, and meat markets, might be pursuaded to invest in American refrigerators providing parties interested in the sale of such wares were here personally to point out the merits of the goods.

The establishment of agencies under foreigners, unless said foreigners have money invested in the manufacture of the wares, will not pay in Genoa.

JAMES FLETCHER,
Consul.

UNITED STATES CONSULATE,
Genoa, February 1, 1890.

PALERMO.

REPORT BY CONSUL CARROLL.

Refrigerators were introduced into Palermo about one year ago, since which, it is understood, about forty have been sold.

To suit the requirements of this district, refrigerators should be of medium size, gorgeous in finish, and moderate in price, the maximum not to exceed 100 lire, or about $20 each. Walnut, or imitations thereof, embellished by various decorative designs, would take well, so would also pitch-pine, similarly finished. All articles, in order to find favor or a market here, must be of a gaudy nature, as a rule.

The refrigerators in use here are of German manufacture, but are generally represented to have been manufactured in the United States.

Refrigerators should be of various sizes and forms, showy or attractive in appearance, with brass or nickel knobs or other showy material. The most expensive refrigerator in Palermo is understood to be offered for 250 lire, or about $50, but few, if any, at this price can be sold. The refrigerator which is understood to have met with the most favor here thus far, costs 60 lire, or about $12. Refrigerators whose forms are somewhat similar to book-cases or ladies' dressing-cases, containing a mirror, would, it is said, meet with great favor here.

Ice is manufactured in Palermo, and costs, at retail, from 4 to 6 cents per kilogram, depending on the season and the weather; the wholesale price thereof varying in like manner, but never being less than 2 cents per kilogram, and often 3 or 4, or more. Snow is also used, and costs from 3 to 5 cents per kilogram retail and about 2 or 3 wholesale, the price, however, varying as in the case of ice.

Unquestionably not only refrigerators but all other articles of American manufacture are more popular here than those of any other country, and the best proof of this is the fact that nearly every dealer or merchant advertises American articles for sale, while the great majority have not a single article of American manufacture in stock; but as a good business appears to be transacted in thus misleading the public, dealers are happy and content.

The best manner of introducing refrigerators here is for dealers therein to send samples of each variety to some reliable person, in order that those desiring them may see by comparison the difference between the spurious and genuine American article. They should be offered for sale on the same conditions accorded dealers here by the Germans, English, etc., which is from three to six months' credit. Few, if any, houses in Palermo can be induced to pay upon delivery.

There is no method of preserving foods or liquids save leaving the doors and windows of butcher-shops open during the night, in order to let in the cool air, the reverse being done during the day. In private houses liquids, and such meats, etc., if any, as may be in the house, are placed on the balconies with a view of preserving them.

Living is so expensive here, and the people generally so poor, that the purchase of meats and certain other articles of food has become somewhat of a science, so that when the meal is completed there is nothing left, as a rule, to preserve. Hence the necessity for refrigerators is not great.

PHILIP CARROLL,
Consul.

UNITED STATES CONSULATE,
Palermo, January 29, 1890.

SOUTHERN ITALY.

REPORT BY CONSUL CAMPHAUSEN, OF NAPLES.

In answer to questions 1, 2, 3, and 4 of the circular, I respectfully report that the use of the refrigerator is at present almost as unknown in this district as in the time of the old Romans.

The Neapolitan keeps no private stores on hand, nor is provision made for more than a single day. Thus, after the hour of dining, even in houses of the wealthy, little else than bread and macaroni will be found.

Most Neapolitan families employ male cooks, who purchase all provisions, and it is not considered advisable to allow them more than the limited sum of money necessary for each day's supply. Every morning the cook provides a stock for the day of meat, fish, vegetables, fruit, and milk. Butter is brought to customers in pails of fresh water. Since the spring of 1885 Naples obtains an immense quantity of the purest water from the Apennines, which is always quite cold, even during the hottest part of the summer.

As Italians prefer olive-oil in cookery to butter, the latter is only bought for table use, and not kept on hand in any quantities.

Butchers, restaurants, wine merchants, fish venders, and dealers in petroleum have grottoes in which to preserve their wares. Tufa rocks extend along the entire north and west of the city of Naples at an elevation of from four to seven hundred feet. Innumerable grottoes have been cut into these rocks, for the double purpose of obtaining the tufa stone for building purposes and of using the grottoes for cellars and store-rooms. The best of these are reached through long tunnels or passages, ending frequently in immense caverns.

The object of the long passage is to exclude outside air. The annual rent of such a grotto or cave is from 150 to 200 francs.

During the summer months comparatively little meat is consumed in this climate, the poorer classes living exclusively on bread, vegetables, macaroni, and fruit. Butcher-shops during that part of the year are only open in the forenoon. The meat remaining unsold at noon is returned to the grotto until next day. Meat inspectors daily visit the butcher-shops and confiscate all tainted meat.

It is extremely difficult to introduce new inventions among a people who use tools and farming utensils which are fac similes of those excavated at Pompeii and Herculaneum, exhibited in the museum at Naples.

The municipal authorities of the city of Naples for the consideration of 200,000 lire per annum have granted to the "Societa delle Neviere" the monopoly or exclusive right to sell snow or ice in the city of Naples.

This society manufactures ice to a very limited extent, but sells large quantities of snow collected on the Apennines, which is preferred by the people here. The *modus operandi* of procuring snow is as follows: During the coldest part of the winter holes are dug on the mountains at an elevation of about 2,500 or 3,000 feet above the level of the sea. These holes are filled with snow, packed down as solid as possible and covered with the leaves of the chestnut tree to a sufficient height to protect the snow against rain, etc. From these holes the snow is packed in straw mats or baskets, transported on mules or donkeys to the nearest railroad station, and thence to the cities. The supply for Naples is brought from Monte San Angelo, about 16 miles from Naples.

The Societa delle Neviere had to enter into a bond in the amount of 100,000 lire for the true performance of their agreement. They are obliged to have at all times a sufficient quantity of ice and snow on hand in their warehouse or cellar at Naples, and supply purchasers at the rate of lire 4.55 per 100 pounds (lire 10 per 100 kilo). Retailers are allowed to sell snow or ice obtained from the society at the rate of 9 centimes per pound.

EDWARD CAMPHAUSEN,
Consul.

UNITED STATES CONSULATE,
Naples, January 21, 1890.

VENICE.

REPORT BY CONSUL JOHNSON.

The refrigerator as a piece of household furniture has been, until very recently, almost unheard of in this consular district, and is at present far from being in general use. Where foods and liquids have been preserved for any length of time, such as in most of the hotels, butcher shops, and breweries, the most primitive methods of preservation by packing directly in ice have been practiced, and no attempt has been made to economize in the use of ice in such cases.

The people in general use very little ice, and rarely keep perishable foods and liquids in their houses in sufficient quantities to necessitate their preservation for any length of time.

I am informed that in many of the towns of this consular district ice-houses exist, belonging to the communal authorities, or in some cases

to private companies, and in these the butchers of the town can keep their meats, each one by the payment of a small tax, reserving a space in the ice-house for his exclusive use.

In the construction of refrigerators for this consular district no peculiar features are required.

The only manufactory of refrigerators to be found in this district is in the city of Venice, having been started about a year ago by a firm of Germans, the Herion Brothers, who are engaged in various commercial enterprises in this city and who are going into the manufacture of refrigerators as an experimental operation. The specimens I have examined are of simple construction, the wood used being American pitch pine, and the makers claiming that they are made after the latest system in use in Germany.

Ice is secured in the winter from ice-ponds, streams, and bodies of fresh water on the mainland (in the case of Venice) near Mestre, stored in ice-houses, and brought to Venice during the summer in boats, the price of ice per 100 pounds being on an average 45 cents.

Outside of those refrigerators made by Herion Brothers there are to be found in Venice a very limited number of refrigerators of German make and these sell at prices slightly higher than those of domestic make, but as the sale of refrigerators generally speaking is so restricted, the greater part of the merchants here do not care to risk importing them.

The best manner of introducing the American refrigerator would be to have samples at the shops of the principal dealers in the important towns of this district, as Venice, Verona, Treviso, etc., bearing in mind that the chief requisite for a ready sale and general popularity is a diminutive price, as high-priced goods would be absolutely unsalable here no matter what superior qualities the article might possess.

H. ABERT JOHNSON,
Consul.

UNITED STATES CONSULATE,
Venice, July 12, 1890.

RUSSIA.

REPORT BY CONSUL-GENERAL CRAWFORD, OF ST PETERSBURG.

Refrigerators are little known here; they are exclusively used at restaurants and shops as yet. Many houses in this city have ice-cellars in which is stored the ice necessary for the season. Artificial ice is unknown here.

On inquiry I have learned that refrigerators are considerably used in the western and southern provinces; but these refrigerators in no way compare in excellence with those of American manufacture.

In my opinion there is a large and lucrative field in Russia for this industry, and American firms would do well to open it up and work it.

J. M. CRAWFORD,
Consul-General.

UNITED STATES CONSULATE GENERAL.
St. Petersburg, January 25, 1890.

FINLAND.

REPORT BY VICE-CONSUL DONNER, OF HELSINGFORS.

There are no refrigerators in use in this country.

The railway carriages used for the transport of butter, etc., are kept cool in summer by putting ice in an iron cylinder, about 2 feet in diameter, which is placed horizontally across the carriage inside. Steamers use small ice-safes for the purpose of preserving the food during the voyage.

Any one who chooses may take ice from the sea or the lakes in Finland, so that the cost is only that of the labor employed.

As there is at the present time increasing attention given to the export of butter, etc., from this country, I think if I could be furnished with specifications of smaller and larger refrigerators, together with the prices delivered here, there might be a good opening for their introduction into Finland. If the manufacturers would like to send samples of the machine they should be forwarded by the Wilson line from New York, via Hull, to Helsingfors.

HERMAN DONNER,
Vice and Acting Consul.

UNITED STATES CONSULATE,
Helsingfors, January 14, 1890.

REFRIGERATORS IN GENERAL USE IN POLAND.

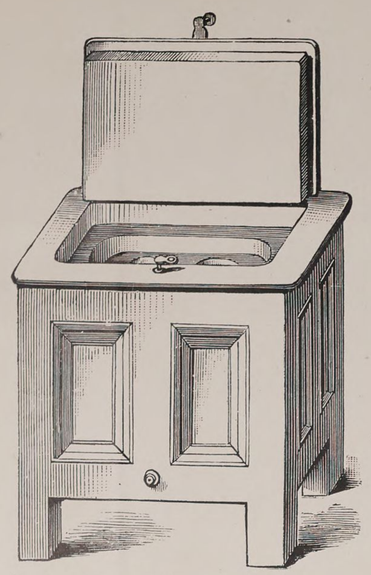


FIG. 21.—These conservators proved better than the foreign ones, as they consume 50 per cent. less ice and 50 per cent. better freeze, while their prices are very moderate. No. 1, with two porcelain gallipots of 6 pints each, costs 55 rubles; No. 2, with two gallipots of 8 pints each, costs 60 rubles; No. 3, with two gallipots of 10 pints each, costs 65 rubles.

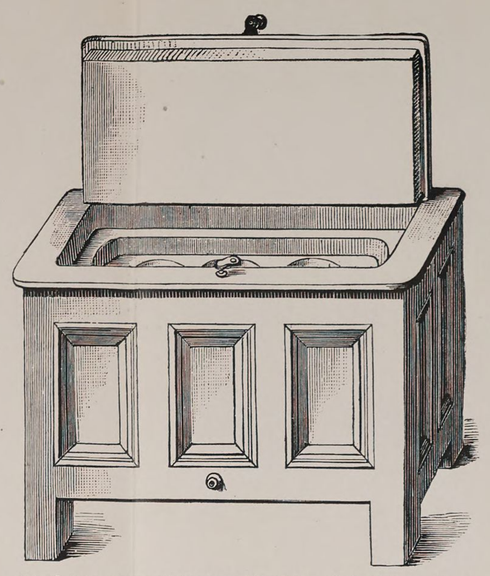


FIG. 22.—Ice conservator with three porcelain gallipots. No. 1, with three gallipots of 8 pints each, costs 80 rubles; No. 2, with three gallipots of 10 pints each, costs 90 rubles; No. 3, with three gallipots of 12 pints each, costs 100 rubles.

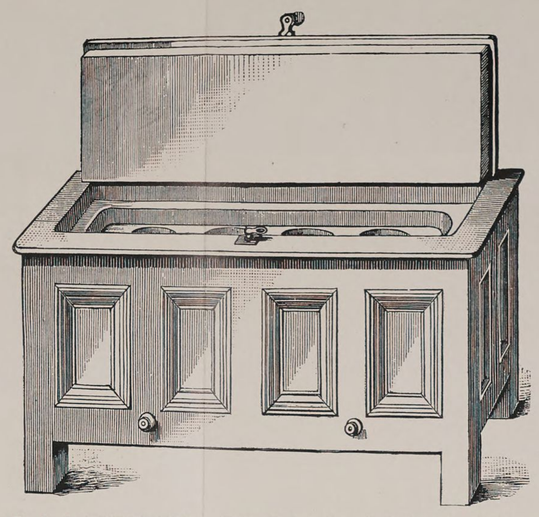


FIG. 23.—Ice conservators with four gallipots. No. 1, with four gallipots of 8 pints each, costs 110 rubles; No. 2, with four gallipots of 10 pints each, costs 120 rubles; No. 3, with four gallipots of 12 pints each, costs 135 rubles.

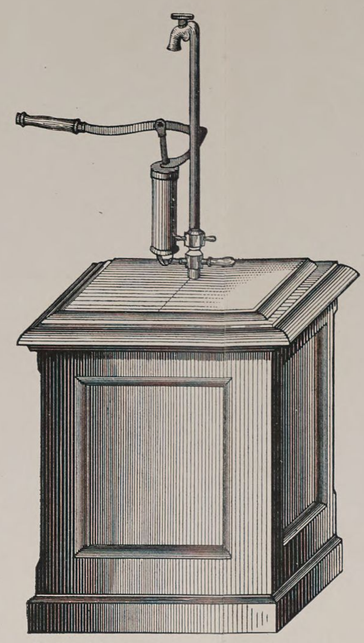


FIG. 24.—Refrigerator for one beer barrel without pump. Price, 30 rubles.

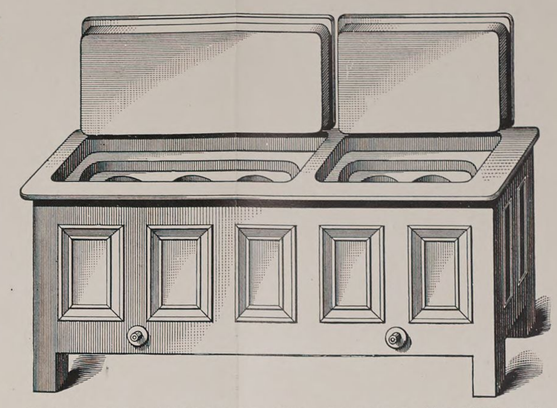


FIG. 25.—Ice conservator with five porcelain gallipots. No. 1, with five gallipots of 8 pints each, costs 120 rubles; No. 2, with five gallipots of 10 pints each, costs 150 rubles; No. 3, with five gallipots of 12 pints each, costs 175 rubles.

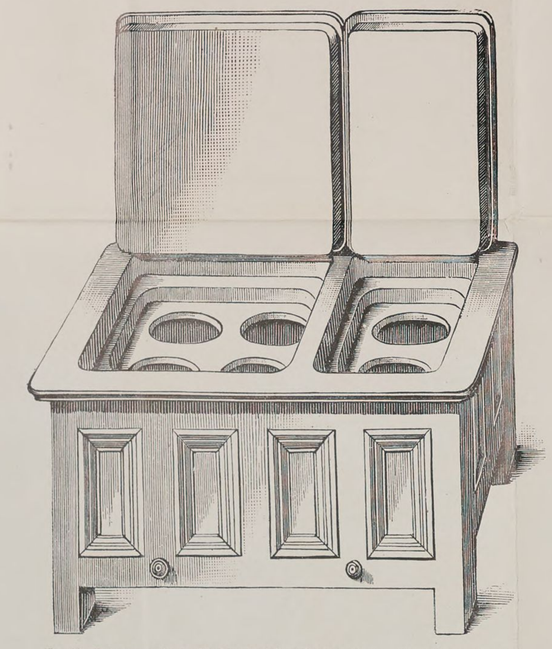


FIG. 26.—Ice conservators with six porcelain gallipots. No. 1, with gallipots of 8 pints each, costs 150 rubles; No. 2, with gallipots of 10 pints each, costs 175 rubles; No. 3, with gallipots of 12 pints each, costs 200 rubles.

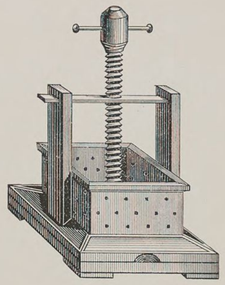


FIG. 27.

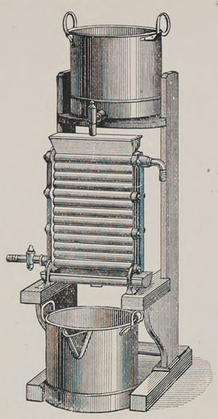


FIG. 28.—Apparatus for cooling milk; costs 45 rubles.

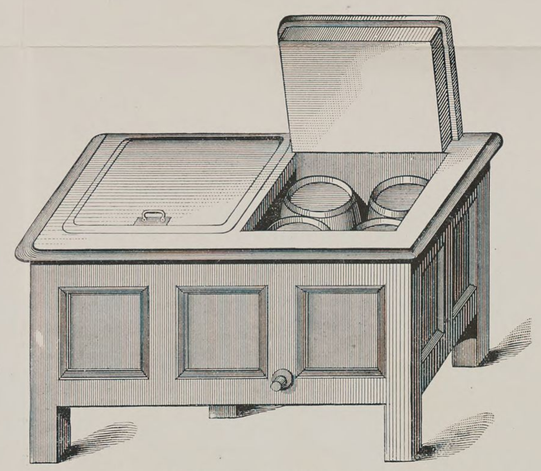


FIG. 29.—Refrigerator for milk with eight pots; costs 85 rubles.

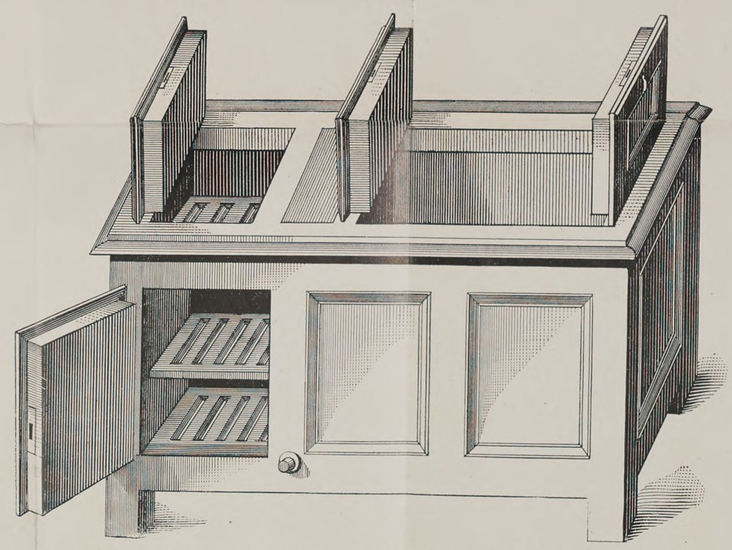


FIG. 30.—Refrigerator for meats and victuals, with one pantry and three upper doors; costs—No. 1, 80 rubles; No. 2, 100 rubles.

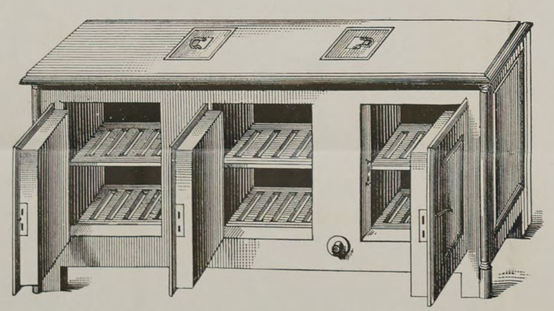


FIG. 32.—Refrigerator with three pantries for victuals and beer. Price, 85 rubles.

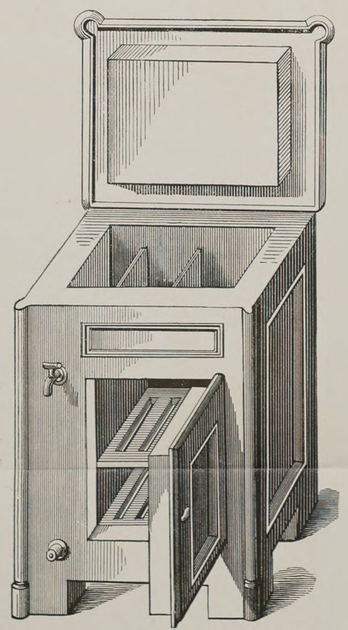


FIG. 33.—Refrigerator with cooling apparatus and a brass cock for drinking water with one pantry. Price: No. 1, 45 rubles; No. 2, 50 rubles; No. 3, 55 rubles; No. 4, 60 rubles; No. 5, 65 rubles; No. 6, 70 rubles.

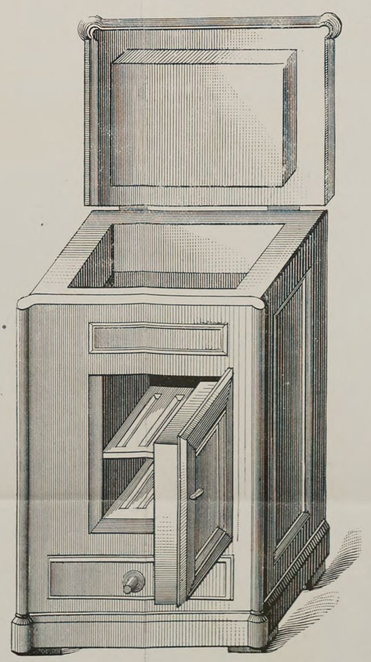


FIG. 34.—Refrigerator with one pantry and one door; costs—No. 1, 40 rubles; No. 2, 45 rubles; No. 3, 50 rubles.

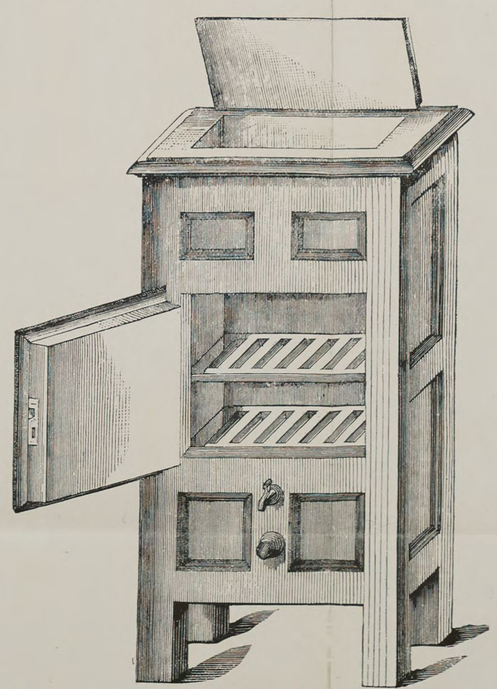


FIG. 35.—Reservoirs for confectioners, with one pantry for cooling water; costs—No. 1, 90 rubles; No. 2, 100 rubles; No. 3, 115 rubles.

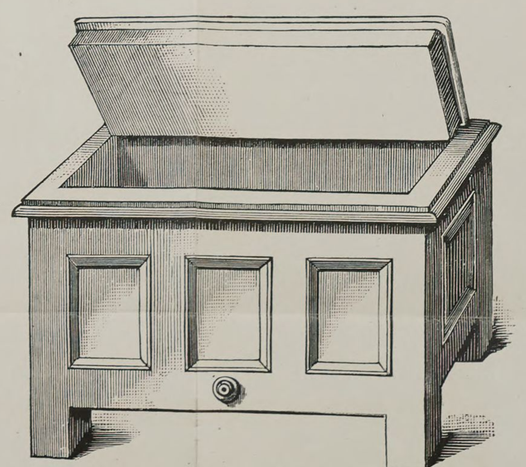


FIG. 36.—Refrigerator with one door for victuals and beer; costs—No. 1, 35 rubles.

POLAND.

REPORT BY CONSUL RAWICZ, OF WARSAW.

Refrigerators for the preservation of foods and liquids are extensively used in this consular district. The refrigerators are constructed in such sizes and shapes as suit the house furnitures of different classes of the population of this country. As I was informed, it is a fact that all refrigerators now in use in Poland are exclusively manufactured in the city of Warsaw, from whence they are also exported to the Russian western governments.

The ice is usually secured in the winter season, during which both ice dealers and brewers supply themselves with the necessary quantity of ice drawn either from the Vistula River or from the neighboring ponds. Its price depends on the season and ranges from 10 to 15 cents per 100 pounds.

The American system of refrigerators can be introduced here and compete with the local one if it will prove cheaper and more convenient.

JOSEPH RAWICZ,
Consul.

UNITED STATES CONSULATE,
Warsaw, January 21, 1890

REFRIGERATORS IN GENERAL USE IN POLAND.

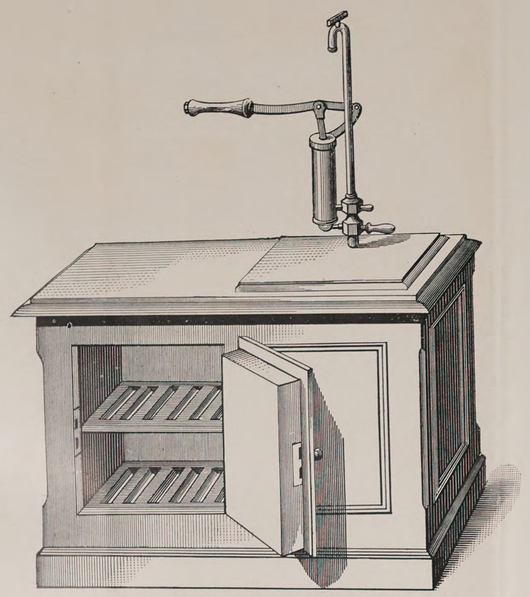


FIG. 37.—Refrigerator with one pantry and for one beer barrel connected with a pump; costs 45 rubles.

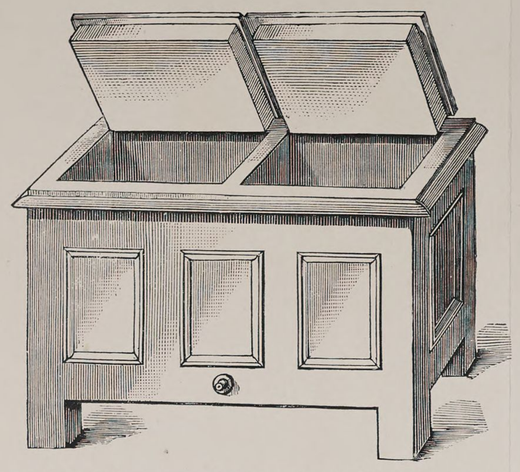


FIG. 38.—Refrigerator for preserving victuals and meat, with two doors; No. 2, costs 45 rubles.

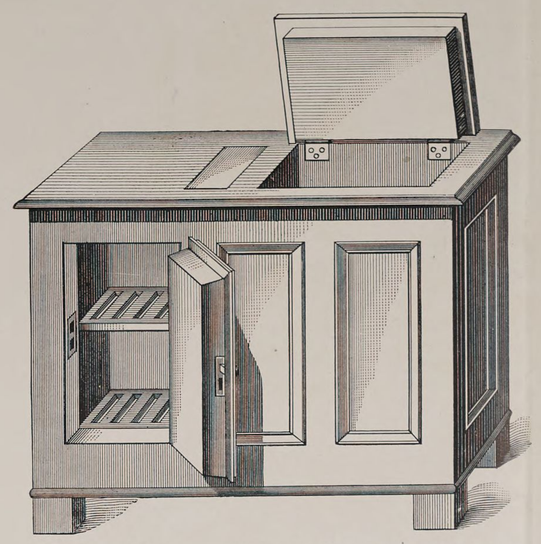


FIG. 39.—Refrigerator for preserving victuals, with one door and a pantry. Price, 50 rubles.

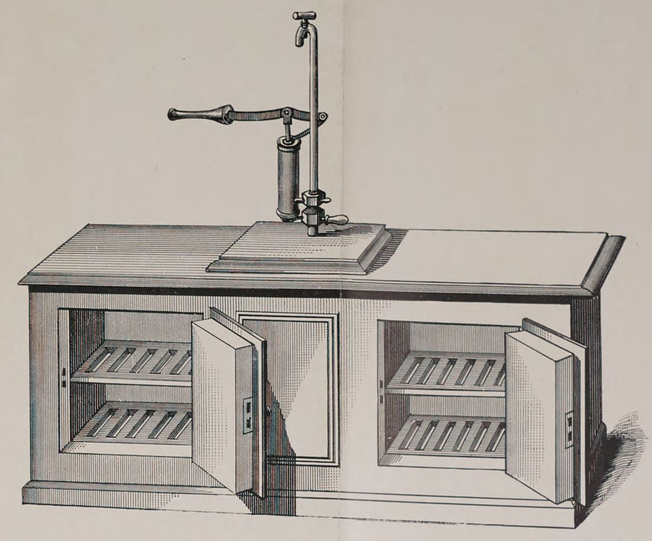


FIG. 40.—Refrigerator for one beer barrel connected with a pump, with two pantries. Price, without pump, 75 rubles.

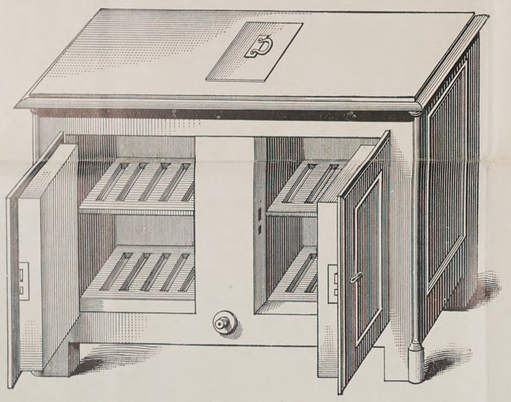


FIG. 43.—Refrigerator with two pantries and four grates; costs—No. 1, 50 rubles; No. 2, 60 rubles; No. 3, 70 rubles.

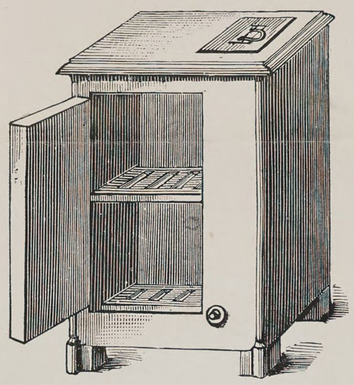


FIG. 44.—Room refrigerator, with one pantry and one side gallipot for ice; costs—No. 1, 25 rubles; No. 2, 30 rubles; No. 3, 35 rubles.

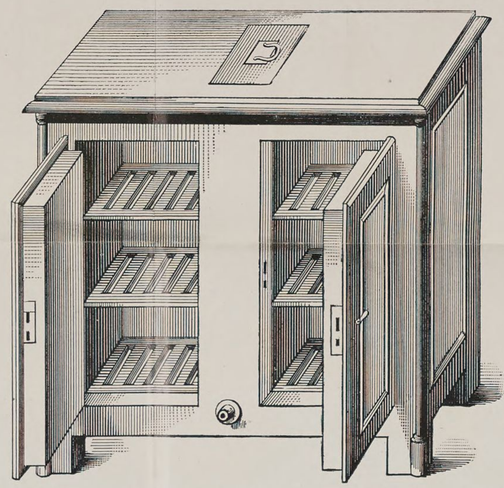


FIG. 45.—Refrigerator with two pantries and six grates; costs—No. 4, 80 rubles; No. 5, 90 rubles; No. 6, 100 rubles; No. 7, 120 rubles.

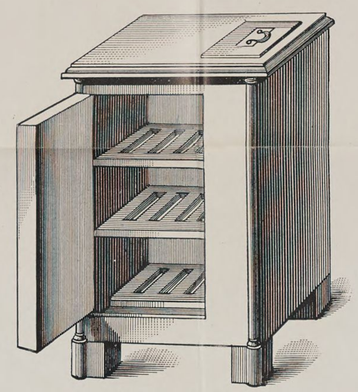


FIG. 46.—Room refrigerator with one pantry and three grates; costs—No. 4, 40 rubles; No. 5, 45 rubles; No. 6, 50 rubles.

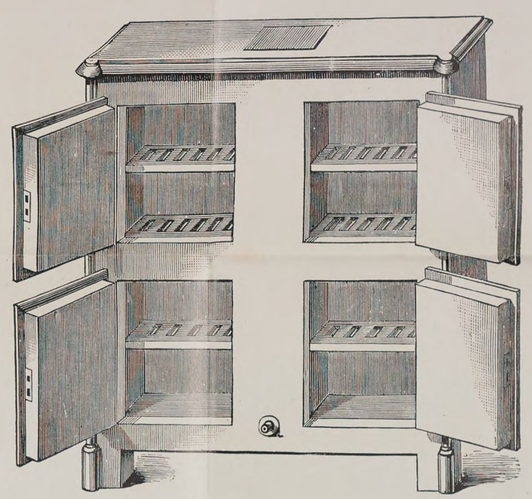


FIG. 47.—Refrigerator with four pantries and six grates; costs—No. 1, 115 rubles; No. 2, 125 rubles.

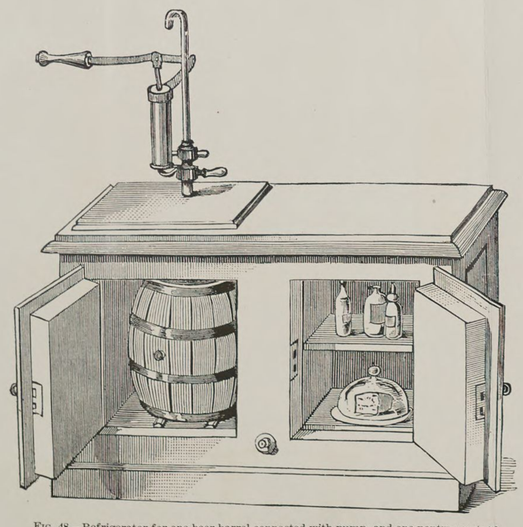


FIG. 48.—Refrigerator for one beer barrel connected with pump, and one pantry; costs 50 rubles.

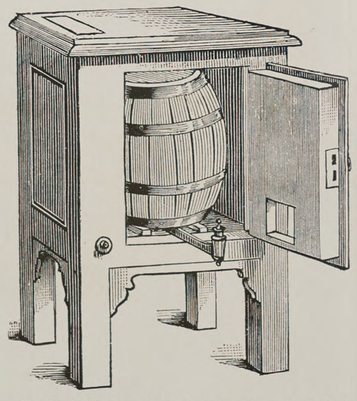


FIG. 49.—Refrigerator for one beer barrel connected with an air-cock; costs—No. 1, 35 rubles; No. 2, 40 rubles. Like refrigerator with two pantries costs, No. 4, 75 rubles.

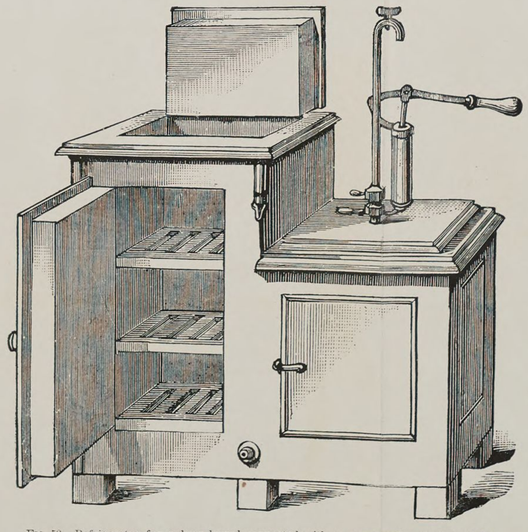


FIG. 50.—Refrigerator for a beer barrel connected with a pump, and a pantry; costs—No. 1, 60 roubles, and No. 2, 70 rubles.

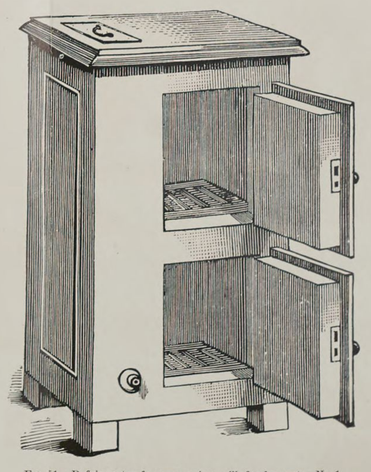


FIG. 51.—Refrigerator for preserving milk foods; costs—No. 1, 50 rubles; No. 2, 60 rubles.

SPAIN.

BARCELONA.

REPORT BY CONSUL SOHEUOH.

Refrigerators are virtually not in use in Barcelona, Catalonia, or the Balearic Islands, and as all food and necessaries of life are strictly bought fresh from day to day, I think refrigerators will not be appreciated for many years as they are in other European countries. Private families never use ice at home, excepting the few English and German families. I remember Mess. Ros y Ca of this city, then dealers in American goods, imported some five years ago six refrigerators, and after two years' unsuccessful efforts sold them to several foreign families at ruinous prices, losing duty, freight, insurance, etc.

The restaurants, coffee-houses, saloons, and hotels receive daily during the summer quantities of ice-snow gathered in the neighboring hills, placing it in their cellars. This sort of ice is cheap, often dirty, but suits all their purposes, selling at $1.50 per 100 pounds. Some years ago a Norwegian house here brought a cargo of fine ice from Norway and lost heavily. The snow-ice gathered in the hills is placed in deep ice-wells, and brought in summer daily in carts to the city. Two years ago an artificial ice factory was started, but, as already stated, the Catalonians using no ice at home, this factory depends entirely on hotels, restaurants, etc., doing little business on account of the cheapness of the snow ice, the city tax on manufactured ice being high.

My opinion is the introduction of refrigerators will be very difficult in this district, as it will take years to convince the people at large of their great utility.

FREDK. H. SCHEUCH,
Consul.

UNITED STATES CONSULATE,
Barcelona, January 26, 1890.

CARTHAGENA.

REPORT BY CONSUL MOLINA.

There are no refrigerators used in my consular district. The people are not accustomed to preserving food.

We use artificial ice, and this is simply used in summer drinks. The price of ice is about $2 per 100 pounds.

C. MOLINA,
Consul.

UNITED STATES CONSULATE,
Carthagena, January 31, 1890.

GRAO OF VALENCIA.

REPORT BY CONSULAR AGENT MERTENS.

American refrigerators are not known here. A few years ago a German house sent here a few refrigerators, which were sold after some time at half their cost price. They did not please the buyers, because there was no economy of ice in their use.

The ice used here is artificial, and its manufacture is not of a superior kind, the ice being too soft. Besides this, the snow which falls during winter time on the surrounding mountains is gathered in and stored in rice husks.

There is not such a general use of ice here for preserving foods and liquids as in the United States, and the little which is used for refreshing the beverage at dinner time is generally sent after to the manufacturers.

Restaurants and hotels keep their daily need of ice preserved in a heap of rice husks in the cellar or a cool place of the house.

My opinion is that even a very plain and economical kind of refrigerator would find difficulty in selling here, as there is little desire amongst the natives of this place to spend money for household improvements, and the number of foreigners is very small. The latter, however, possess this article, imported mostly from Germany.

THEODOR MERTENS,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Grao of Valencia, January 8, 1890.

CADIZ.

REPORT BY CONSUL TURNER.

Replying to Department circular regarding refrigerators, I have the honor to inclose herewith replies to same from the consular agents at Jeres de la Frontera, Seville, and Port St. Mary's. I can add but little to what these inclosures contain. Ice sells here at 5 cents per pound to small consumers, and is used in sparing quantities, except in the manufacture of iced drinks, etc.

Fresh meat during the summer is obtainable only in the morning. It is prepared for market during the night, and every butcher expects to dispose of his entire stock before the following noon.

The first and only cargo of ice ever landed here from abroad came from Boston in 1856. It arrived in June, and was not discharged for several weeks on account of the stupidity of the custom officers, who insisted that it must be landed on the docks in a burning sun and weighed as other cargo. This was prevented by the governor of the

province, who interfered in behalf of the shippers. It was the first ice ever seen by many people and attracted large crowds.

Regarding the introduction of American methods of preserving fruits, vegetables, meats, etc., I must differ from Mr. Hall, for living must always be high here so long as the hand to mouth process to which he refers continues. The abundance of prosperous years is wasted for lack of methods of preservation. The distress following partial or total failure of crops is always doubly great because the excess of fruitful years has not been preserved. In this land of fruit peaches sell for 20 cents per pound, the dried article for 35 cents. Green apples and pears sell for 15 cents per pound. Preserved fruits are hardly known.

It is difficult to tell how our goods and methods can be introduced when there is no such thing as an American doing business here. All these things would naturally and rapidly introduce themselves were this country traversed by salesmen representing American merchants and American goods. In the absence of such a force, and in the absence also of a direct trade in breadstuffs, canned meats, vegetables, fruits, etc., between this country and the United States, I see no method of bringing about the desired results, if it is not done by private enterprise. I believe it would pay our farmers if the Department of Agriculture would demonstrate the cheapness and purity of our canned goods and the uses of Indian maize at Spanish fairs. In closing I might add that the expressed observations of all American travelers that I have had the pleasure of meeting since coming to Cadiz are in harmony with everything that has been written in favor of trade with this country.

The high prices of all kinds of food supplies surprise all.

I am informed by the captain of the American bark *Kennard*, which trades regularly between Boston and Fayal, that Cadiz is a much better point than Fayal for trade, and he proposes changing accordingly. He has posted himself on prices while here for future use.

R. W. TURNER,
Consul.

UNITED STATES CONSULATE,
Cadiz, January 29, 1890.

JEREZ DE LA FRONTERA.

REPORT BY CONSULAR AGENT HALL.

[Inclosure 1 in Consul Turner's Report.]

Refrigerators.—In this district I consider myself as authorized in saying that refrigerators are not only unknown but that they are unnecessary, owing to the simplicity of the Spanish cuisine.

Spanish families, high and low, make their market purchase daily, and only in such quantities as shall be necessary for the consumption or use of the day.

It is doubtful whether in any family, no matter what its social standing is, such a thing as a roast of veal, leg of mutton or pork, or a fowl would be found from one day to another. Pies, cakes, custards, etc., are unknown culinary luxuries.

I am confident there is no opening for the introduction of refrigerators in this district.

Preserving foods and liquids.—This is completely unknown in all senses. A long residence in this country warrants me in affirming that preserving fruits, fowls, meats, fish, etc., is only done by the use of spirits of wine for fruit, and oil and lard for the other articles mentioned.

Ice.—This article, manufactured in Seville, is only used during the summer, when it is used for making ice creams, etc. It wholesales in this city at $2 per hundred weight, and retails at from 3 to 5 cents per pound.

SEVILLE.

REPORT BY CONSULAR AGENT CALDWELL.

[Inclosure 2 in Consul Turner's Report.]

Refrigerators are not used here. Ice is manufactured here, and sells in summer for 7½ pesetas per 100 pounds and in winter for 14 pesetas per cwt. Food is bought from day to day. I think there is no opening for American refrigerators.

PORT ST. MARY'S.

REPORT BY CONSULAR AGENT DANIELS.

[Inclosure 3 in Consul Turner's Report.]

Referring to the refrigerator circular you sent me a few days ago, I regret to say that, after making all possible inquiries, I am unable to give answers to its questions, for I find that refrigerators are not used, or even known, here. The very small consumption of ice is provided for by supplies from Seville, the price of which I am unable to give, for it is only used during the summer months. It is used only for iced drinks, and the price varies.

MALAGA.

REPORT BY CONSUL MARSTON.

Refrigerators are not used in this part of Spain.

The ice used in Malaga is artificial, and only to be had from May until October, and very little is used, except in cases of illness. Spaniards never drink ice water as in the United States. There are two ice

factories in the city of Malaga. A single kilo costs 1½ reais (about 7½ cents), or you can purchase a package of ice tickets of 30 tickets each at the following prices, viz: 30 tickets of 1 kilo each, $1.64; 30 tickets of 2 kilos each, $3.08; 30 tickets of 3 kilos each, $4.53; 30 tickets of 6 kilos each, $8.88; 30 tickets of 10 kilos each, $14.47. The above is delivered at your door at any regular hour you may state. The manner of living here does not require the use of either ice or refrigerators. There are no milk cans, consequently no butter is made in this part of Spain. All butter is imported in cans, mostly from Ireland or Copenhagen. The milk used is goat's milk, these goats being driven from door to door in the early hours of the morning, the servants purchasing what each family requires. The cook goes to market every morning and makes her purchases for the day. Meat is but little used, even by the well-to-do, hardly ever by the middle classes, and it is a rare occasion when the poor ever taste it, bread, fish, and vegetables being the principal diet. In Malaga the fish is the very best, and it can be bought at any hour of the day, passing your door, fresh from the Mediterranean, at a very small cost, and is never purchased until required for cooking. This state of things dispenses with the necessity of all classes of refrigerators, for none could be sold here.

H. C. MARSTON,
Consul.

UNITED STATES CONSULATE,
Malaga, January 20, 1890.

GIBRALTAR.

REPORT BY CONSUL SPRAGUE.

Refrigerators are very little used in this city.

The very few in use possess no peculiar features, either in construction or application.

Those in use are generally of English manufacture.

Ice is manufactured at the north front, outside the gates of this garrison, from rain-water, and is sold at about $3 per 112 pounds, but can be obtained much cheaper if regularly taken in larger quantities.

Provisions and liquids are generally kept in underground cellars and stores during the summer months, so that refrigerators are not in any demand.

HORATIO J. SPRAGUE,
Consul.

UNITED STATES CONSULATE,
Gibraltar, January 14, 1890.

SWEDEN.

GOTHENBURG.

REPORT BY CONSUL MAN.

Refrigerators are not nearly so extensively used here as in the United States but are nevertheless quite generally found in the city and country houses of the middle and upper classes.

There are no peculiar features required in the construction of refrigerators for this district.

They are manufactured at so called "mechanical workshops" which are extensive concerns, engaged in the manufacture of a large line of articles composed more or less of metal, and embracing all varieties of kitchen utensils, stoves, farming implements, plumbers' materials, tools, machinery, etc., even constructing steam-ships and armored war vessels.

The general dimensions of the refrigerators in use here are confined to three sizes, the smallest being 2½ feet square; the middle and most used 2½ feet front width, 2½ feet side width, and 3 feet in height; the largest 2½ feet front width, 2½ feet side width, and 4 feet in height.

These consist simply of a zinc-lined wooden box protected by an intermediate non-conductor furnished with a door in front, a lid on top, and several galvanized wire racks, the ice being nearly at the bottom of the chest, while the racks are above it.

The prices for these three sizes at retail are, respectively, $8.58, $9.38, and $12.06.

Ice is cut from the lakes and rivers by the brewers, and supplied by them to the public at an average price of 37 cents a hundred pounds.

As to the best method of introducing them into this country I am of the opinion that the only advisable way would be through energetic agents, who, by convincing the people of the superior qualities of the American refrigerator, could find a market for them here, notwithstanding the low prices of the Swedish article, and the fact of the strong disinclination of the people to adopt new methods at a greater outlay.

ERNEST A. MAN,
Consul.

UNITED STATES CONSULATE,
Gothenburg, February 14, 1890.

STOCKHOLM.

REPORT BY CONSUL ELFWING.

I have not been able to find the use of any refrigerators anywhere in Sweden, nor do I believe that the introduction of them there could meet with success. Ice in this cold climate is a very cheap and hardy article; it is sold at retail here in Stockholm, delivered in the houses, at about 40 cents per 100 pounds. Breweries and like establishments which use much take up their own quantities and pay, of course, much less. There is never any warm or hot weather; perhaps for a couple of weeks in July or August it is hot, and nothing is therefore done for the preservation of food and liquids.

NERE A. ELFWING,
Consul.

UNITED STATES CONSULATE,
Stockholm, January 28, 1890.

SWITZERLAND.

HORGEN.

REPORT BY CONSUL ADAMS.

In the forest and mountain cantons, which occupy nearly the whole of this district, the refrigerator is an article hardly needed or known. The altitude of the region and the vicinity of perpetual ice and snow keep the temperature down, except in midsummer during the day-time, while for the leading industries of the country, lumbering and cattle-raising, temperature is almost a matter of indifference. So far as I can learn it is only in the large dairies (butter and cheese factories) that artificial refrigeration is employed. In these the chamber for storing milk, as it is delivered by the neighboring herdsmen, is converted into a refrigerator by cementing the floor and the walls for a foot or more above the floor, and introducing flowing water from the nearest brook. The milk, placed in shallow wooden (usually ash) vessels, is surrounded by the water. As water is supplied in abundance by the melting snows and ice, at the cost of a little ditching and piping, the system is not likely to be superseded. It is only in the valleys and lowlands, where the conditions are different, that the questions of the circular apply.

In this lower region, refrigerators are in common use, especially in the towns where they are to be found in nearly all the larger hotels, boarding-houses, restaurants, and hospitals, in the shops of butchers, poulterers, fishmongers, and pastry cooks, in many public institutions and private families. In the country the large dairies use them in place of the mountain system, but not the farmers, who now deliver all their milk to the dairies.

The butchers use a refrigerator of large dimensions, with an outer case of stone or cement, and an inner one of wood lined with zinc. In others in use there seem to be no peculiar features of construction.

Most of the refrigerators in this district are of local manufacture. Perhaps 10 per cent. come from Germany or Holland.

The sizes vary from 1 by 1 by 1 meter to 5 by $1\frac{1}{2}$ by $1\frac{1}{2}$ meters. They usually consist of an inner case, zinc-lined, separated by a packing of sawdust or pulverized charcoal from the outer case. The ice-box is

filled from the top, and fitted with drain-pipe and tap. The following table gives details:

Refrigerators used by--	Dimensions in meters.	Prices.
Dairies	1 to 1¾ by 1 by 1	$14 to $23
Butchers	5 by 1 by 1	75 100
Poulterers		15 80
Hotels	3½ to 5 by 1½ by 1 to 1½	96 150
Pensions	1 to 2 by 1 by 1	15 96
Pastry cooks	1 to 2 by 1 by 1	15 40

The dairies use 2, or more; the butcher 1; poulterers 1 to 3; hotels 3 to 5; other establishments usually 1.

Ice, supplied by the lakes and ponds, usually not of the best quality, is abundant in summer at 40 cents per 100 pounds retail, and $1.93 per wagon-load wholesale.

Finally, as to the readiness of the people to adopt the American system of preserving foods and liquids, as much would depend on the economy as on the superiority of the system. A market might be found, at least in the larger Swiss towns, for the American article if it could be shown by actual trial to be more efficient than the local article at the same cost, or equally efficient at a less cost. It would be well, perhaps, for manufacturers to communicate with the leading hotels of the country, whose managers are more attentive to matters of this sort than any other class interested. None of the dealers in American goods here import direct. The general importers at Basle or Geneva might be induced to do so.

LYELL T. ADAMS,
Consul.

UNITED STATES CONSULATE,
Horgen, January 30, 1890.

ZURICH.

REPORT BY CONSUL CATLIN.

Refrigerators are extensively used in this consular district. Their sizes and formations are extremely varied in character. So far as I have been able to learn, none of them possess any peculiar features not known to manufacturers elsewhere. A large number of those in use are manufactured in Switzerland—there are two factories here in Zurich, and many are made by individual joiners—but in this, as in everything else, German competition is overwhelmingly strong, and the Swiss makers have all they can do to stem the tide and keep up their prices to paying rates. I have heard of an English refrigerator having been imported hither, but it does not seem to have elicited further orders of the same kind. The Swiss and German articles control the market.

Owing to the number of beer saloons, both large and small, and the necessity of keeping and serving the beer cool during warm weather,

the number of refrigerators of a medium size in actual use is much larger than it would be in a non-beer-drinking community of the same population. Refrigerators are also used by the hotels, great and small, boarding-houses, restaurants, butchers, confectioners, apothecaries, hospitals, and to a limited extent in private families.

In size and formation, as above stated, they greatly vary. I give herewith a description of a number of those here offered for sale:

No. 1.—Ice chamber on top. Refrigerator divided into three compartments, viz, (1) with room for two kegs of beer of 100 liters each, one being on draught while the other is cooling; (2, middle) for keeping raw meats in large pieces, game, poultry, and fish; (3) for cooling food, bottles, and glasses; outer measurements, side compartments (1 and 3) 1.65 meters long, .85 wide, 1.75 high; middle compartment (2) 1.53 meters long, .90 wide, 2.40 high; price only obtainable by purchase.

No. 2.—Ice chamber on top. Refrigerator has room for 10 kegs of beer of 80 liters each, 2 of them on draft while the rest are cooling; also room for food, bottles, and glasses. Takes 2,000 pounds ice. Length 4.50, width 1.29, height 2.25 meters.

No. 3.—Ice chamber on top and sides. Has room for 4 wine jugs of 18 liters each, and 2 kegs of beer of 50 liters each on draft; also 3 spaces for glasses, bottles, and food. Takes 600 pounds ice. Length 3.21, width .87, height 1.59 meters.

No. 4.—Desk form. Cushioned doors, if desired. Ice chamber on top. Has two compartments, for keeping raw meat, game, poultry, and fish cool. Takes 640 pounds ice. Length 1.85, width .92, height 1.61 meters.

No. 5.—Secretary form. Ice in center, for cooling all kinds of food and bottled liquids. Made in five sizes.

	Length.	Width.	Height.	Ice.		Length.	Width.	Height.	Ice.
	Meters.	*Meters.*	*Meters.*	*Pounds.*		*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A	0.96	0.63	1.08	90	D	1.80	0.78	1.80	280
B	1.29	0.69	1.38	160	E	1.90	0.85	1.98	340
C	1.47	0.78	1.68	240					

No. 6.—Sideboard form. Ice chamber above; contains four separate compartments for preserving cooked food and liquids of all kinds on marble slabs; is finished in oak, is similarly decorated on both sides, and can be placed in the center of a dining-room. Takes 300 pounds ice. Length 2.71, width .76, height 1.04 meters. Marble slabs extra.

No. 7.—Sideboard form for smaller hotels, restaurants, boarding-houses, and large families. Ice-chamber above. Takes 130 pounds ice. Length 1.03, width .88 (below), .63 (above), height 2.16 meters.

No. 8.—Ice chamber above. Contains two separate compartments. Length 1.28, width .68, height 1.69 meters. Takes 140 pounds ice.

No. 9.—Bureau form. Ice-chamber in upper center. Length 1.32, width .68, height 1.32 meters. Takes 100 pounds ice.

No. 10.—For small families. Ice-chamber at side.

	Length.	Width.	Height.	Ice.		Length.	Width.	Height.	Ice.
	Meters.	*Meters.*	*Meters.*	*Pounds.*		*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A	1.02	0.65	0.84	60	B	1.21	0.76	1.00	110

No. 11.—For small families. Ice chamber below.

	Length.	Width.	Height.	Ice.		Length.	Width.	Height.	Ice.
	Meters.	*Meters.*	*Meters.*	*Pounds.*		*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	0.70	0.52	0.65	30	C.....	1.40	0.76	0.94	110
B.....	0.98	0.65	0.84	60					

No. 12.—For same. Ice chamber above. One compartment. Length .87, width .71, height 1.52 meters. Takes 110 pounds ice.

No. 13.—For apothecaries, doctors, and hospitals. Bureau form. Ice chamber at side. Length 1, width .60, height 1 meter. Takes 150 pounds ice.

No. 14.—For cooling bottles or preserving victuals. Ice chamber above. Finished as a piece of furniture with double front. Length 1.15, width .75, height 1.15 meters. Takes 140 pounds of ice.

No. 15.—Ice chamber in center. Has four separate compartments for preserving foods and liquids. Length 1.38, width .67, height 1.01 meters. Takes 80 pounds ice.

No. 16.—Desk form. For butchers and sausage-makers. Ice chamber below. Has two separate compartments. Length 1.85, width .76, height 1.05 meters. Takes 200 pounds ice.

No. 17.—Desk form. For same. Ice chamber below. Length 1.36, width .72, height 1.05 meters. Takes 160 pounds ice.

No. 18.—For cooling beer. Ice chamber above. Holds four kegs of beer, two on draught while the others are cooling. In three sizes, according to size of kegs, viz:

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters.	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A	60–70	1.60	0.93	2.30	700	C	20–30	1.00	0.70	1.08	280
B.....	40–50	1.30	0.80	2.00	400						

No. 18.—For cooling beer. Ice chamber on side.

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	60–70	1.96	0.93	1.93	600	C....	20–30	1.30	0.70	1.50	220
B.....	40–50	1.60	0.80	1.70	500						

No. 20.—For cooling beer. Ice chamber above. Holds two kegs of beer on draught.

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters.	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	60 70	1.45	0.93	1.70	400	C	20–30	1.30	0.70	1.40	300
B....	40–50	1.45	0.80	1.55	320						

No. 21.—For cooling beer. Ice chamber above. Holds one keg on draught, with space for keeping food, bottles, etc.

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters.	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	60–70	1.45	0.93	1.70	300	C	20–30	1.05	0.70	1.45	160
B.....	40–50	1.30	0.80	1.55	220						

No. 22.—For cooling beer. Ice chamber on side. Holds one keg beer with low pressure.

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters.	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	60–70	1.25	0.78	1.05	200	C	20–30	1.04	0.55	0.75	1.30
B.....	40–50	1.10	0.65	1.90	160						

No. 23.—For cooling beer. Ice chamber on side. Holds one keg beer with low pressure.

	Kegs.	Length.	Width.	Height.	Ice.		Kegs.	Length.	Width.	Height.	Ice.
	Liters.	*Meters.*	*Meters.*	*Meters.*	*Pounds.*		*Liters.*	*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A.....	60–70	1.30	0.93	1.45	220	C	20–30	1.00	0.70	1.20	90
B.....	40–50	1.15	0.80	1.30	150						

No. 24.—Washstand form, with faucets. Ice chamber on side. For keeping four different kinds of beer on draught and cooling drinking water. Length, 0.80; width, 0.70; height, 0.75 meters. Takes 260 pounds ice.

No. 25.—For confectioners and pastry cooks. Ice chamber in center. Has two compartments for preserving and cooling unbaked dough, eggs, butter, cream, etc. Length, 1.50; width, 0.81; height, 0.87 meters. Takes 140 pounds ice.

Ice boxes for keeping raw ice are made in various sizes, viz:

	Length.	Width.	Height.	Ice.		Length.	Width.	Height.	Ice.
	Meters.	*Meters.*	*Meters.*	*Pounds.*		*Meters.*	*Meters.*	*Meters.*	*Pounds.*
A	0.84	0.84	0.96	200	G	1.29	1.29	1.41	1,400
B	0.96	0.96	1.08	400	H	1.33	1.33	1.45	1,600
C	1.05	1.05	1.17	600	I	1.38	1.38	1.50	1,800
D	1.14	1.14	1.26	800	K	1.41	1.41	1.53	2,000
E	1.20	1.20	1.32	1,000	L	1.44	1.44	1.56	2,200
F	1.24	1.24	1.36	1,200	M	1.47	1.47	1.59	2,400

The various sizes and formations here described—it is impossible to obtain the prices in any case without actually purchasing—will enable our American manufacturers to form a fair idea of the demands of the trade in this section.

Ice sells at from 18 to 24 cents per 100 pounds when delivered in large quantities and at from from 30 to 40 cents in smaller lots. It is obtained from the neighboring lakes—the Greifensee, the Katzensee, and other smaller bodies of water. The Klönthalersee, in the neighboring canton of Glarus, freezes over every winter. The glaciers are also made, in Canton Wallis, tributary to the demand which, of late years, owing to the growth of the Swiss beer-brewing industry, has become enormous. The four hundred breweries in Switzerland alone

consume 100,000 tons annually, at an expense, including freight and labor, of 500,000 francs. The manufacture of artificial ice has consequently greatly developed, there being two firms in this city and one at Geneva engaged in the business.

For the introduction of American refrigerators into this district a sharp, pushing agent, provided with a full line of samples and speaking the German language thoroughly, would be the first requisite. The appointment of a local agent here would hardly suffice; he must be a man thoroughly conversant with the American trade and manufacture, and should be sent out for that purpose. Even then his success would depend entirely on whether he could compete in prices with the local and German manufacturers. The former have no freight or entry duties to pay; the latter, too, are near by, and, spite of the duties, can, it seems, deliver their goods here at competing prices. But when the freight from New York to Zurich, plus the entry duties, come to be added to the original price of an American refrigerator, be its merits what they may, it will require a sharp and tireless salesman here to overcome the local competition and make the sale of the American article a paying one in this remote inland market.

GEORGE L. CATLIN,
Consul.

UNITED STATES CONSULATE,
Zurich, January 23, 1890.

TURKEY.

REPORT BY CONSUL-GENERAL SWEENEY, OF CONSTANTINOPLE.

Refrigerators are not used in this consular district, except in a very few houses or hotels. The refrigerators in use are of European or local make; and should any American refrigerators be introduced into this district they should cost very little. People in this country, however, as a general rule, have a very primitive way of preserving foods and liquids by keeping them in subterranean caves or cellars. The best manner of introducing refrigerators in this district is by continued advertisement on a very extended scale, both in all the newspapers published in this city and in all conspicuous places, such as hotels, beer establishments, clubs, etc.

Ice is secured in this district by manufacture by a company which obtained an imperial concession for the exclusive manufacture of this useful article. The factory is situated at Stenia, one of the villages on the European side of the Bosphorus. The use of ice is rather limited in this country, as heretofore it was secured only from its natural sources; but it is increasing gradually. The price per 100 pounds of ice is $1.

In conclusion I beg to remark that this district may adopt the American refrigerators if they can be manufactured in such a way as to sell very cheaply.

Z. T. SWEENEY,
Consul-General.

UNITED STATES CONSULATE,
Constantinople, January 14, 1890.

THE UNITED KINGDOM.

ENGLAND.

BIRMINGHAM.

REPORT BY CONSUL JARRETT.

Refrigerators are used in this consular district chiefly by butchers and fishmongers and at hotels and large restaurants. By private families, so far as I can find, they are used to a very limited extent only.

There are no peculiar features required in the construction of refrigerators so as to adapt them for use in this country. Those now in use in large establishments are very similar in construction to American refrigerators, but though the general features of smaller refrigerators adapted for family use are similar to those of American make, there is a marked difference in their construction, the American being better in design and utility. I may add that the price of American refrigerators is lower than the price of similar ones of English make.

The large fixed refrigerators for preserving perishable food are manufactured in this consular district. Those for the brewery purposes are manufactured in Burton-on-Trent. Small refrigerators for family use are not manufactured here. The principal of this class of refrigerators in this country are of Manchester make.

The ice used in this consular district is all manufactured, being the product of the Linde British Refrigeration Company, a concern that not only manufactures ice for consumption in England, but also on the Continent. Natural ice is imported into this country at London and Hull, from Norway. Last year it was about 200,000 tons at London and about 75,000 tons at Hull. The price of ice a short time ago was very low, being about $1.93 per ton. A consolidation of the different concerns then existing was effected, when the price of ice was considerably advanced. Mr. G. H. Jackson, of the Linde British Refrigeration Company, limited, has kindly furnished me with the following present selling price of ice:

	Per ton.*
Birmingham	$7.29
London	4.38 to 7.29
Grimsby and Hull	4.86½
Cardiff	6.08
Liverpool	4.38 to 7.29

The concern that does the largest business in the sale of refrigerators in this city is that of Evans & Matthews. Their sales amount to

*2,240 pounds.

about two hundred and sixty in each year. The manager informs me that the sales of Mr. Kent, of London, will not exceed sixty per week during the summer season.

Should the American manufacturers conclude to introduce their refrigerators into this district, I can not suggest any better means than that they do so through Evans & Matthews, as I know it to be the most reliable house doing business in that line in the Midlands. I may say, in conclusion, that the climate of this country is not the most favorable to insure the general use of refrigerators. The temperature rarely exceeds 85° Fahrenheit. Warm periods of long duration seldom take place. This probably accounts for the fact that refrigerators have not been adopted into general family use, even by persons of fair means.

JOHN JARRETT,
Consul.

UNITED STATES CONSULATE,
Birmingham, January 28, 1890.

BRADFORD.

REPORT BY CONSUL TIBBITS.

Refrigerators are used in this consular district, but only to a comparatively limited extent. Their use is mainly confined to hotels, and the better class restaurants, eating-houses, and fish and game markets. They are found in but few private residences, and only in those of the wealthy class. Regarded as household necessities in the United States, they are here considered articles of luxury. In the town of Bradford, with a population of nearly 250,000, there are but two firms that deal in refrigerators, and inquiries made of them disclose the fact that their combined annual sales will not average more than 6 dozen.

No particular features are required in the construction of refrigerators adapted for use in this district.

The refrigerators in use in this district are manufactured in the United States and by a single firm in London. The American refrigerator principally in use is that known as the "Alaska."

The sizes of refrigerators kept in stock by local dealers are as follows:

	Width.	Depth.	Height.	Price.		Width.	Depth.	Height.	Price.
	Inches.	*Inches.*	*Inches.*	£ *s.*		*Inches.*	*Inches.*	*Inches.*	£ *s.*
No. 2....	27	21	30	4 4	No. 4..	39	24	32	6 6
No. 3...	33	22	31	5 5	No. 6...	50	27	34	8 8

The ice here in use is imported from Norway. The price per 100 pounds varies from 3 to 5 shillings, the former rate being charged when delivery is at the place of sale, and the latter when it is at the premises of the purchaser. The retail price is 3 pence per pound.

Where refrigerators are not in use, foods and liquids are preserved in cellars, and the temperature is rarely high enough to cause any difficulty to be experienced.

The American refrigerators, as at present constructed, met all local requirements in this district and are, according to the statements of the local dealers, considered superior to those of home manufacture.

Taking into consideration the climatic conditions that here prevail, and the high price which ice must always command owing to the lack of any home product, there is but little room for any substantial extension of trade by American manufacturers of refrigerators in this consular district.

JOHN A. TIBBITS,
Consul.

UNITED STATES CONSULATE,
Bradford, January 21, 1890.

BRISTOL.

REPORT BY CONSUL DELILLE.

The use of refrigerators is extending in Bristol. To begin with the Bristol Dock Company, it is noteworthy that their refrigerating plant at Avonmouth is now extensive. There are, however, no peculiar features in the construction of these refrigerators. They were supplied by Messrs. Pontifex & Wood, Shoe Lane, London, England, and are on the ammonia principle, with brine circulation in the cold stores, the contract amount of heat to be eliminated per hour being 267,000 British thermal units; and the cost, inclusive of buildings and steam boilers, £2,288 ($11,134.55). In my opinion, an excellent opening is now offered for the introduction and sale of refrigerators of American manufacture throughout the Bristol and West of England district. One recent and noteworthy event confirms this view. The large firm of Messrs. Nelson & Son, meat importers, of London and Liverpool, have lately opened a branch establishment of their business in this port, and are now having constructed spacious buildings for the storage of meat. The refrigerators which they will use are of American manufacture, being named the "Hercules," and are supplied by a Chicago firm.

In Messrs. Nelson & Son's new Bristol meat-houses there will be five storage chambers of considerable dimensions. Eventually, the firm hope to receive their dead meat from South America by fast steamers plying direct to Bristol instead of London. Bristol would thus become the distributing center for the whole of the West of England, and indeed, thanks to the economy of time and money by this transit, this port may perhaps attain to the position of supplying London with frozen meat, instead of being supplied therefrom as at present. It will thus be seen that American refrigerator manufacturers might do well

to turn their attention to this part of the United Kingdom, especially as their machinery has been so favorably brought under public notice by Messrs. Nelson & Son's selection, as noted above, of the "Hercules" patent.

From special inquiries on the subject, I have reason to believe that soon there will be a large demand among the local butchers, fish-mongers, and Bristol trades-people generally, for the smaller sized refrigerators so extensively used in the United States. Up to now very inadequate methods of preserving foods and fluids have prevailed here among this class of people.

As to ice, the local supply is fairly abundant, being almost entirely in the hands of Messrs. Bigwood, fish and ice merchants, who import nearly all their ice from Norway. Very little is manufactured on the spot. The wholesale price is 30 shillings ($7.29) per ton.

JOHN D. DELILLE,
Consul.

UNITED STATES CONSULATE,
Bristol, February 14, 1890.

FALMOUTH.

REPORT BY CONSUL FOX.

The temperature here is very mild, and refrigerators are not required.

Butchers' meat, etc., which is not disposed of when fresh, is salted for use of ships.

The best way of introducing refrigerators in the west of England would be to exhibit them in the north and west of England and royal Cornwall agricultural shows.

HOWARD FOX,
Consul.

UNITED STATES CONSULATE,
Falmouth, February 17, 1890.

LEEDS.

REPORT BY CONSUL WIGFALL.

Inquiry addressed to house-furnishing firms in Leeds has elicited replies to the following effect.

One says:

> The trade you refer to is a very limited one with us, and appears to be very well met by the freezers we buy from the United States through factors.

The freezers referred to by this firm are presumably ice-cream freezers, and not refrigerators.

Another answer, concerning the extent to which refrigerators are used in this district gives for hotels and restaurants universally; public houses very little; private residences in town moderately; in country very little.

The leading confectioner and caterer in Leeds, who is constantly employed for private entertainments, and who would therefore naturally be conversant with such details among the well-to-do classes of the community, thinks, as a rule, in the houses which he knows, that refrigerators are not in use.

The impression derived by the writer himself from personal observation is quite in accord with this last-expressed opinion. The mere fact of the use of a refrigerator in a private house would indicate a style of living more than simply comfortable. It would be the exception rather than the rule to find them where incomes were less than £1,000 ($4,866.50), and doubtless even at a higher range of expenditure their employment is not universal.

It can not be said that there are any peculiar features required in the construction of refrigerators for use here. The chest-shaped refrigerator is said to be the shape usually sold, and my informant states that an effort to introduce the cabinet or upright shape was not successful, as he thinks.

The bulk of the refrigerators used here come from London and Birmingham, according to my advices. No importations from the United States have come to my knowledge.

Sizes of refrigerators in use and likely to meet with sale are given by one firm as ranging from 18 inches high, 24 inches wide (front), 18 inches deep (front to back), for the smallest size, to 24 inches high, 36 inches wide (front), 24 inches deep (front to back), for the largest size. Range of prices, according to quality and finish: Small size, $14.60 to $19.47; large size, $29.20 to $48.67.

The 24 by 36 by 24 inches is quoted by this firm as the most convenient and best suited to ordinary use, selling at retail at from $29.20 to $34.07.

Another estimate of size makes them vary from 22 by 20 by 29 inches to 7 feet 6 inches by 10 feet by 2 feet 6 inches, with prices rising from $12.17 to $243.33.

They mention a size of about 27 by 21 by 30 inches as most convenient and best suited to ordinary use, and quote a price therefor of $21.90 to $24.33.

A third firm names the dimensions as here:

Smallest size, 30 inches high, 22 inches wide (front), 20 inches deep (front to back). Range of price for such a size, according to quality and finish, $17.88 to $23.60.

Largest size, 36 inches high, 50 inches wide (front), 27 inches deep (front to back). Range of price for such a size, according to quality and finish, $38.32 to $45.99.

Average size most convenient and best suited to ordinary use 33 inches high, 26 inches wide, 24 inches deep (back to front). Such a refrigerator would be sold at retail for $24.33.

The conditions of climate are not such in this district as to necessi-

tate the employment of artificial temperatures for the preservation of perishable articles. Many years go by without bringing weather, beyond a few days perhaps, when a refrigerator would be of use; and it may be said that it never is warm enough to require such appliances beyond a few weeks during the twelve months, and even that at broken intervals. Every house occupied by persons whose circumstances would warrant the outlay necessary to obtain a refrigerator is provided with cellarage, where meat, vegetables, and so forth are kept before being used. These cellars, while below the exterior level of the ground, are generally well ventilated, and, being furnished with stone tables, they serve the purpose of a cold-air chamber, with the great advantage of abundant space and conveniences of storage.

If United States manufacturers were prepared to place sample stocks at central points and advertise and solicit, it is quite probable an increase in the demand for refrigerators could be brought about, and possibly a remunerative trade established. The progress at first would in all likelihood be slow. The tendency here, however, is continuously in the direction of luxury, and the ability to buy, once granting the existence of the wish, is beyond any peradventure. Trade of all kinds is flourishing, and there could hardly be a more propitious time than the present for the introduction into general use of anything designed to add to the comfort of living.

Ice at retail is only to be had from fishmongers, who, in connection with their regular business, are in the habit of supplying ice to those who require it. There are no regular ice dealers making that their sole business in Leeds. This fact alone would seem to show how far from general is the use of ice in the community.

Two of the largest fishmongers in Leeds report sales of ice; one at the rate of 2 to 3 tons per week, the other at 4 tons per week in winter and 12 to 15 tons in summer. A ton a week is 320 pounds a day, which would give thirty-two families 10 pounds a day. There are probably seventy-two thousand families averaging five persons each in Leeds at the present time. The dealer last referred to sells about six refrigerators in a season, and says the principal demand for ice is for hotels and restaurants.

Retail prices of ice in Leeds are about as follows:

Less than 7 pounds at a time, 3 to 4 cents per pound.
Per 7 pounds, $18\frac{1}{4}$ to $24\frac{1}{3}$ cents per 7 pounds.
Per 14 pounds, $18\frac{1}{4}$ to $36\frac{1}{2}$ cents per stone.
Per 56 pounds, $48\frac{1}{2}$ to 61 cents per half hundred-weight.
Per 112 pounds, 73 to $97\frac{1}{3}$ cents per hundred-weight.

The last price, it will be observed, makes an average of about three-quarters of a cent a pound for 112-pound parcels.

F. H. WIGFALL,
Consul.

UNITED STATES CONSULATE,
Leeds, February 10, 1890.

LIVERPOOL.

REPORT BY CONSUL SHERMAN.

Refrigerators are used in this consular district, but only to a very limited extent, confined almost wholly to butchers.

There are no peculiar features required in the construction of refrigerators in this district.

The refrigerators in use in this district are manufactured in Liverpool.

Those used by butchers are of all sizes and a variety of forms. Those for the larger butchers are made on the principle of a steamer's ice-house, holding say 30 hundred-weight to 2 tons of ice, leaving room to hang joints from bars running through near the top. Few are used in families, and the style preferred seems to be that shown with prices in the annexed cut marked A.

It is a double box with two lids, the inner one being lined with zinc and fitted with shelves. The space between the two is filled with charcoal or sawdust.

The ice is placed in the bottom of the inner box.

Three-fourths of the ice used in Liverpool is brought from Norway, and the remaining one-fourth is manufactured here.

The retail prices are as follows:

	s.	*d.*
Under 12 pounds, per pound	0	1½
12 pounds	1	0
28 pounds	1	6
35 pounds	2	0
42 pounds	2	6
56 pounds	3	0
1 cwt	5	0

Much lower rates are charged to people contracting for stated quantities regularly.

The wholesale price is 25 to 40 shillings ($6.08 to $9.73) per ton.

There is and can be but very little demand for refrigerators for family use in this climate, where all ordinary food of the household can be kept sufficiently well in all seasons without them.

One dealer advertises "The American Refrigerator" for family use, but evidently very little effort is made to push it.

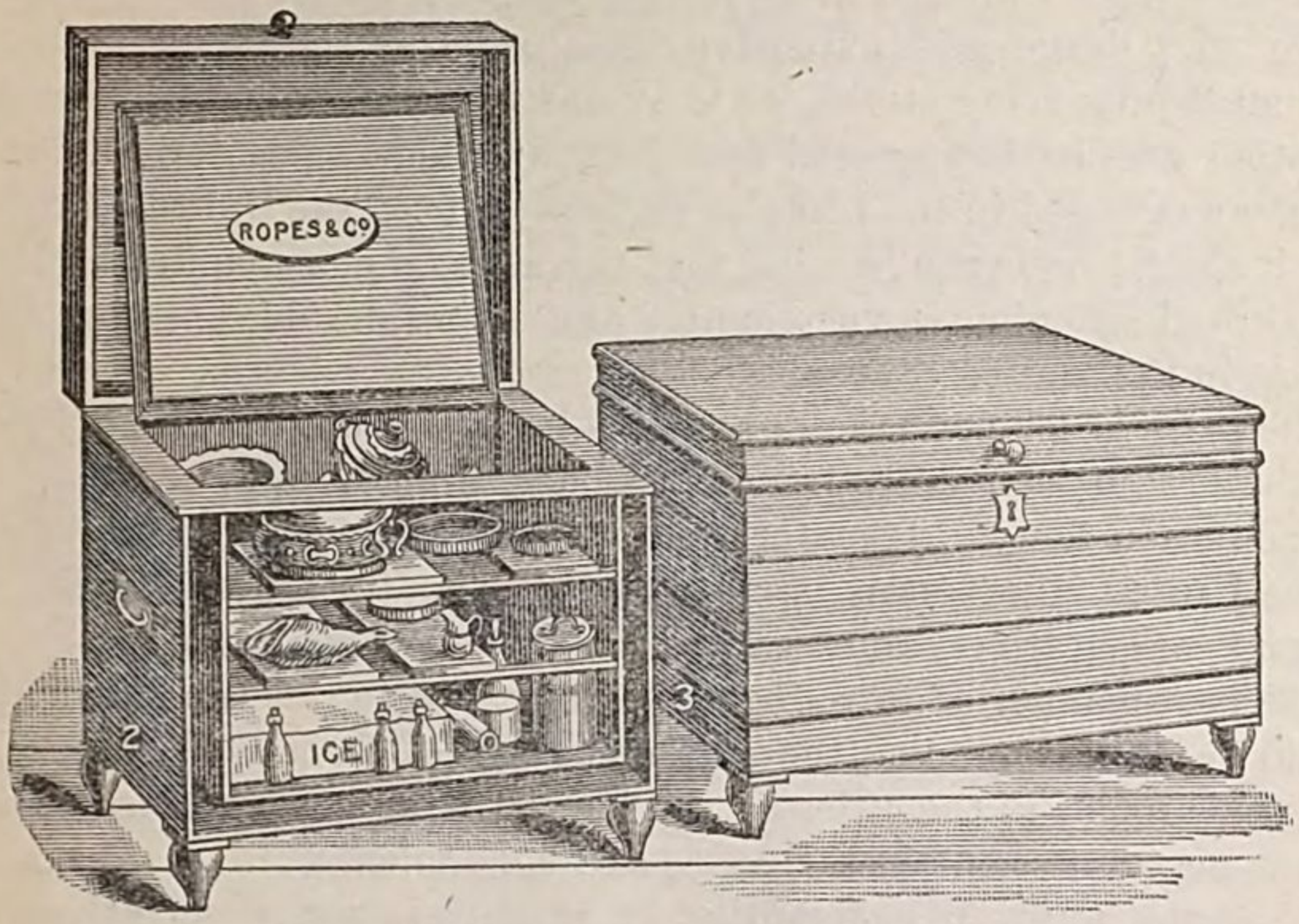
As to the best manner of introducing refrigerators into this district, I can only say that if some active and enterprising local agent were to take a well-made, serviceable, low-priced refrigerator for family use he might find many customers.

THOS. H. SHERMAN,
Consul.

UNITED STATES CONSULATE,
Liverpool, January 21, 1890.

Refrigerators, or portable ice-houses, to preserve the ice and furnish a provision safe under one lock.

[Inclosure in Consul Sherman's report.]



EXTERIOR DIMENSIONS.

	Length.		Width.		Height.		Price.			Length.		Width.		Height.		Price.	
	Ft.	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	£	*s.*		*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	£	*s.*
No. 1	1	6	1	1	2	2	2	10	No. 4	3	6	2	4	2	11	6	0
No. 2	2	4	1	9	2	4	3	10	No. 5	4	0	2	8	3	2	8	0
No. 3	3	3	2	1	2	8	5	0									

LONDON.

REPORT BY CONSUL-GENERAL NEW.

I have personally visited or been in correspondence with all the extensive manufacturers and dealers in refrigerators of whom I have had or could obtain any knowledge, and will answer the interrogatories of the Department as best I can from the information thus obtained.

Refrigerators are used in this consular district quite extensively in the larger meat and vegetable warehouses and markets, but to a very limited extent for domestic or household purposes.

While no peculiar features in the construction of refrigerators exist in this district other than would be required for like purposes in the United States, yet as a matter of fact the refrigerators are here more generally permanent fixtures rather than movable furniture, as with us, when they are used for ordinary or household purposes.

They are mostly manufactured within this district, although there are a few houses dealing in American refrigerators.

They are of all sizes and prices; of those that are permanent fixtures,

they being constructed by special contract because of convenience, location, and adaptation, it is not possible to give cost, being cost of days' labor and material used; but of those that are movable and made in numbered sizes I furnish herewith price lists from the leading dealers.

For very large and extensive uses, such as the larger breweries and meat-preserving stores, ice is extensively manufactured here, but for other uses ice is imported from Norway, there being several lines of steamers engaged in the trade to various parts of the United Kingdom. But it should be borne in mind that the use and consumption of ice in the United Kingdom is very limited and inconsiderable as compared to its use in the United States.

The price of ice per 112 pounds at warehouses is 28 cents; delivered within a radius of 3 miles from warehouse, from 49 to 73 cents.

The reason that refrigerators and ice are not more extensively used in the United Kingdom is because of the climatic conditions and the general comparatively uniform and moderate temperature.

The best manner of introducing refrigerators in this consular district would be, in my opinion, the establishment of large central agencies and show-rooms in the cities of the United Kingdom, with some competent person to explain their uses and convenience.

I inclose herewith a quantity of literature, viz, descriptive catalogues, price lists, etc, which I have picked up in making the inquiries necessary to furnish the information required by the circular of the Department. The inclosed documents furnished in detail a great amount of information and data that will be valuable to American manufacturers of refrigerators who desire to enter their goods in competition with those manufactured in this country and is largely descriptive of the methods now in use.*

JNO. C. NEW,
Consul-General.

UNITED STATES CONSULATE,
London, February 3, 1890.

THE PONTIFEX ICE-MAKING AND REFRIGERATING MACHINES.

[Inclosure in Consul-General New's Report.]

These machines are now so well known and have been so extensively and successfully adopted that it would almost appear superfluous to enter into any detailed description of their merits and of their system of working. The subject of artificial refrigeration, however, is often not clearly understood. It is a comparatively new one, and has not yet received that attention which has been bestowed on other branches of mechanical science.

Pontifex & Wood, Limited, therefore take this opportunity to bring before their friends a description of their patent apparatus, and to make a comparison between it and other inventions intended to achieve similar results.

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* Only one inclosure printed herewith; the whole being too voluminous for publication.

Ammonia and ether are the only two agents which produce cold sufficiently cheaply for ordinary commercial purposes, and which are not attended with other overwhelming difficulties. The comparison for all practical purposes may, therefore, be confined to them.

The boiling-point of ammonia is 120° lower than that of ether. Its latent heat is nearly six times as great. The tension of its vapor at an equal temperature is nearly thirteen times as great.

Apart from the advantages which ammonia affords in dispensing with the use of large and costly air-pumps, its above-named properties enable it, by the Pontifex process, to produce ice at one-fifth the cost for fuel of its production by ether.

Ammonia also posesses the advantage over ether that it is not inflammable, and the insurance companies therefore make no objection to its use. Neither does ammonia corrode the metal with which it comes in contact; on the contrary, it possesses the property of preserving the iron and steel of which the machine is made. It is also by far the least expensive in its first cost.

At the time the Pontifex ammonia machine was first placed commercially in the market, in 1875, the ether machines which were of earlier invention were already well established as being the only process then available; and in view of the comparatively large first cost and the little understood character of all descriptions of artificial refrigerating machines, it is easily to be understood that the prejudice against any new process was hard to overcome.

However, as time has gone on, the merits of ammonia machines have been realized, and ether machines have been gradually driven out of the market. At this present time scarcely any, if any, of them are being made. Nothing can more clearly show that the ether machines are practically extinct than the fact that the manufacturers of them finding their trade gone are endeavoring to place upon the market various forms of ammonia machines, modified in the hope of evading the patents held by Pontifex & Wood, Limited.

It is, therefore, unnecessary at this date to recapitulate the further advantages which the use of ammonia presents over that of ether, and the comparison rests between the various forms of ammonia machines. Before preceeding with it, however, some description of the Pontifex apparatus will be desirable.

DESCRIPTION OF THE PONTIFEX PATENT AMMONIA ABSORPTION REFRIGERATING MACHINE.

It is a well-known physical law that on the change of any liquid into the gaseous form, with a corresponding increase of bulk, a large amount of its contained heat is rendered latent; and on the reverse operation taking place the latent heat in the gas is rendered sensible, so that it can be readily removed. The Pontifex machine works on this principle. It consists of a number of very strong cast-iron cylindrical vessels connected together by pipes and cocks. The first of these is a large horizontal vessel called the generator, into which a charge of commercial liquor ammonia is placed. This vessel contains a coil of steam-pipes, heated by steam from the ordinary steam-boilers, so as to evaporate the ammonia, which rises up a vertical cylinder called the separator, placed on the top of the generator. This separator is so constructed that any watery vapor rising with the ammonia is condensed and returned to the generator. From the top of the separator a pipe conveys the gas to the condenser, consisting of a number of coils of pipes, contained in a wrought-iron vertical cylinder, which is kept full of water in circulation. In this condenser the evaporated ammonia gas is condensed into a liquid form by the pressure caused by its own accumulation. This liquid next passes to the cooler, which is a vertical cast-iron vessel containing coils of wrought-iron pipes. In the cooler the liquid ammonia, which leaves the condenser at a temperature of about 70° or 80° Fahr. is allowed to expand into gaseous form. In doing so its sensible heat is rendered latent, as above described, and its temper-

ature is ordinarily reduced down to about 10° to 20° Fahr., or say 22° to 12° of frost; but it can be reduced to a much lower point if desired. A circulation of water or brine is run through the coils of pipes in the cooler, and the expanding ammonia gas cools this water or brine down to any desired temperature. After doing this the ammonia gas passes away through a pipe into another vertical cylinder called the absorber, in which it meets with and is absorbed by the water from which it was first evaporated in the generator. From the absorber the liquid ammonia is drawn by pumps which force it back through an economizer or heater (thereby raising its temperature by means of the water which is running from the generator into the absorber) into the generator. From this generator it is evaporated again, and the operation is continuous, the same ammonia and water being used indefinitely.

The method of work is as follows: After all the connections are made, the machine is started by filling the generator with the ordinary ammoniacal liquor of commerce, and a little steam is admitted into the coil of pipes inside the generator, so as to raise just sufficient pressure of gas to expel all the air in the machine through a valve provided for the purpose on the absorber.

When all the air is thus expelled, the full pressure of steam is turned into the generator coil. The ammonia in the solution being very volatile is immediately driven off in the form of gas, and passes through the separator into the top of the condenser, the water of the solution being left behind in the generator.

The condensing water is admitted at the bottom of the condenser and run off at the top, the ammoniacal gas passing down through a coil of pipe contained in the condenser.

The upper part of this coil is called the rectifier, and is fitted at intervals with traps or pockets. The gas, passing down the coil, is cooled by the condensing water, and parts with any watery particles that may have been carried over with the ammonia. This water is caught in the traps and is at once passed out of the coil and returns into the separator.

The ammoniacal gas, after passing the lowest trap, is quite dry or anhydrous, and, as explained elsewhere, the attainment of this perfectly dry ammoniacal gas is the principal cause of the great superiority of the Pontifex machine over all others.

The dry ammoniacal gas continues to pass on down the coil in the condenser until by its accumulation it reaches a pressure at which the gas becomes liquefiable, the liquefaction being greatly assisted by the reduction of temperature due to the condensing water used.

We have now obtained liquid anhydrous ammonia, and the apparatus is so arranged that, as the gas becomes liquefied, it passes into the cooler.

The ammonia in this vessel, being quite free from water, vaporizes, under the ordinary pressure of the atmosphere, at a temperature as low as 60° below freezing point. At any higher temperature it passes freely into a gaseous form, and at the moment of thus changing its form it absorbs and renders latent an immense amount of heat.

The only source from whence it can abstract this heat is from the contents of a coil of pipe provided for that purpose in the cooler cylinder.

In breweries the water to be cooled is passed direct through this coil; and for ice-making a strong solution of chloride of calcium, or brine, as it is called, is passed through it, which, after being cooled to a very low temperature, is pumped to the ice boxes, there to freeze the water and convert it into ice, returning again to the machine to be recooled for further use.

The ammonia, now again in the gaseous form, passes from the top of the cooler into the absorber. A pipe connects this vessel with the bottom of the generator, through which the pressure in the latter forces a constant stream of the water left in it at starting into the absorber. This water, containing little or no ammonia, greedily absorbs the gas coming from the cooler, and the two form a strong solution of ammoniacal liquor similar to that originally put into the generator. This solution is

then drawn away by one of the pumps and forced through a coil of pipe in the economizer or heater G into the top of the separator. The solution, now rich in ammonia, then passes down the cylinder through a series of trays; these trays being heated by the hot vapor rising from the generator, the ammonia is again separated from the water in which it is dissolved, and the solution gradually becomes weaker until it falls into the generator almost entirely exhausted of ammonia.

The ammonia, now once more in the form of gas, passes into the condenser as before, to be again made dry and liquefied, thence to the cooler, where by its reconversion into vapor it again produces the cold, and passes once more back to the absorber and pumps.

Thus the whole process forms a continuous cycle, the same changes from liquid to gas and gas to liquid being constantly repeated, with no destruction of material whatever except of the little quantity of coal consumed under the boiler.

The economizer or heater utilizes the heat of the water as it passes from the generator on its way to the absorber, by heating up the ammoniacal solution before it enters the separator, and so saves steam; whilst at the same time the reduced temperature of the water enables it to re-absorb a larger proportion of ammoniacal gas.

We now proceed to a comparison between the Pontifex absorption and other forms of ammonia refrigerating machines.

First as to other forms of ammonia absorption machines:

English machines, number in use.—There are some two or three other forms of these besides the Pontifex offered for sale in this country. These have been patented within the last twelve months, but so far as is known not one of them has been made and worked. Thus, they have not yet even reached the experimental stage, and it is consequently impossible to make any practical comparison with them.

It will be observed, therefore, that in the United Kingdom the ammonia absorption machines have from the first maintained their pre-eminent position. On the Continent and in America they have only recently been introduced. The latter country is the great field for the use of artificial refrigeration, and the most recent advices from the United States remark that "there is no doubt that the absorption are going to supersede the compression machines."

Foreign machines.—In addition to the English machines above mentioned, there are one or two continental and American manufacturers who have attempted to make ammonia absorption machines. They have, however, lacked the perfect arrangement of analyzer or separator, which is the most important and distinguishing feature of the Pontifex machine, and, therefore, it has been found impossible to work them continuously. In addition to this, they have been so badly designed and constructed that their leakages of ammonia have been excessive, break-downs frequent, and costs of repairs very heavy, so that they have obtained a very bad reputation. None of these machines have been placed on the English markets.

Next as to ammonia compression machines. In these machines the ammonia gas, as it leaves the refrigerator or cooler of the apparatus, is drawn into a gas-pump worked by a steam-engine or other convenient motive power, and there compressed into a liquid by the direct application of the steam power. It is manifest that an enormous amount of steam-engine power is required to work this gas-pump and to compress such large volumes of gas into liquid by means of the heavy pressure which is required for the purpose.

STEAM-ENGINE POWER REQUIRED.

In the Pontifex machine, this is only about one-sixth part of that required by all ammonia compression machines. The following table shows this:

No. of machine.....	B.	C.	D.	D1.	E.	E1.	F.	G.
Size of machine in water cooled from 55° to 45° Fahr. per hour...	450	1,200	2,200	2,750	3,250	4,350	5,500	8,000
Steam-engine power required by the Pontifex machine, about.....	1½	2	3	3½	4	4½	5	6
Steam-engine power required by ammonia compression machines, about, with condensing water at 50°.....	.....	10	15	.....	25	.....	.....	45
Steam-engine power required by ammonia compression machines, about, with condensing water at 85°.....	.....	15	22	.....	37	.....	.....	67

In all such cases the indicated horse-power required, which, of course, is much greater than the "nominal" or "effective," has been taken, including the power required for driving the brine and water circulating pumps.

STEAM-BOILER POWER REQUIRED.

In the Pontifex machine, besides the steam required to drive the small steam engine, some is required for heating the coil in the generator, but the quantity is still very much less than in the ammonia compression machine, as shown by the following comparison:

No. of machine.....	B.	C.	D.	D1.	E.	E1.	F.	G.
Size of machine in water cooled from 55° to 45° Fahr. per hour..	450	1,200	2,200	2,750	3,250	4,250	5,500	8,000
Steam-boiler power required by the Pontifex machine, about.....	4	5	6	7	8	10	12	15
Steam-boiler power required by ammonia compression machines, about, with condensing water at 50°.....	.....	10	15	.....	25	.....	.....	45
Steam-boiler power required by ammonia compression machines, about, with condensing water at 85°.....	.....	15	22	.....	37	.....	.....	67

The amount of coal consumed is approximately proportionate to the amount of steam-boiler power required by the two systems.

These two points, *i. e.*, relative sizes of steam-engine and boiler required, are of the utmost possible importance. With a small engine and boiler, the coal bill is kept small, the amount of lubricant for the engine is reduced, and one man can look after one or even two machines and can also stoke the boiler. With a large engine and boiler, in addition to heavy coal and oil bills, a separate engineer is required to run the machine, and a stoker to look after the boiler. The charges arising from these necessities are constant—recurring daily—and will very soon amount to the value of the machine.

AMOUNT OF CONDENSING WATER REQUIRED.

In consequence of the great height of the Pontifex condenser, the water entering at the bottom is enabled as it rises and gets warmer to continue to do work in cooling the hotter gases as they descend from the top of the coils, consequently much less

condensing water is wanted by the Pontifex than by the ammonia compression machine, as shown by the following comparison:

No. of machine.....	B.	C.	D.	D1.	E.	E1.	F.	G.
Size of machine in water cooled per hour from 55° to 45° Fahr.....	450	1,200	2,200	2,750	3,250	4,350	5,500	8,000
Condensing water at 50° Fahr. required by the Pontifex machine, about, galls. per hour	200	400	800	1,050	1,250	1,700	2,100	3,000
Ditto required by ammonia compression machine, about, galls. per hour.....	.....	750	1,500	.....	2,500	.....	.....	5,000

This question of condensing water is often of the utmost possible importance; as, for instance, in breweries, where frequently the water has to be brought by measure from water companies, or pumped from great depths. In such cases, the smaller consumption of the Pontifex machine is an enormous advantage, and by making special arrangements the quantity can, if required, be reduced still further. It must, however, be clearly understood that the quantity of the water can only be reduced to its minimum when care is taken to keep the condenser coils clean, so that the surfaces may be fully effective; and that care is taken that water is not allowed to run to waste through the machine. If the initial temperature of the condensing water is higher than 50° Fahr. the quantity required is correspondingly increased.

The amounts of steam power and condensing water above given for the ammonia compression machines are taken from the latest issued catalogues of the makers of these machines. Although these quantities can be to some extent varied, it is impossible from the nature of the case that they can be materially altered, except by increasing them.

AMOUNT OF LUBRICANT REQUIRED.

In the Pontifex machine this is reduced to the infinitesimal amount of oil required to lubricate the eccentrics and pins of the ammonia pumps, their plungers or rods being lubricated by water. In addition to this, a little oil or tallow is wanted for the small engine which drives the pumps.

In the ammonia compression machine a very considerable amount of special lubricant is required for the large piston, piston rod, and cylinder of the gas pump, which has to pump a very hot dry gas against a heavy pressure. As ordinary oils are unsuitable for this purpose by reason of their liability to saponification by the ammonia, glycerine, or other special lubricant has to be used and in such quantities that a special pump is generally required to force it into the gas pump cylinder. The glycerine is largely carried over mechanically from the gas pump into the condenser, and to prevent its clogging the machine it has to be drawn off through traps, and to be rectified in a special apparatus to enable it to be re-used. Nothing of this sort has to be done with the Pontifex machine.

DURABILITY AND NON-LIABILITY TO BREAK DOWN.

Wear and tear in all machines only occur in those parts which move or which are liable to corrosion.

In the Pontifex machine the only moving part is a small single or double acting pump with one or two suctions and one or two delivery valves. This pump is of the simplest design, can be repaired by any ordinary mechanic, and gives no more trouble in looking after than a common little boiler feed-pump. It has to pump a comparatively cool liquid solution of ammonia and water, and therefore no trouble is experienced in keeping tight its one stuffing box-joint or gland. It requires no lubrication. To prevent the possibility of breakdown, this, the only moving part of the machine, is generally made in duplicate, with cocks so arranged that if one pump

gets out of order it can be shut off from the apparatus and the other started to work without one moment's stoppage, and repairs to the idle pump can be made while the machine is running. Thus the only moving part of the machine is duplicated so that those having one Pontifex machine are in practically as good a position as those having two of any other design.

In ammonia compression machines, on the other hand, the moving and most important parts consist of a very powerful steam-engine and large dry hot gas pump, with a large and ponderous fly-wheel often weighing several tons, pistons and rods, connecting rods, cranks, shafts, etc. The liability to and cost of repairs and breakdowns is therefore of course proportionately greater.

With regard to corrosion, ammonia either in its anhydrous state or combined with water has no injurious action on iron or steel surfaces with which alone it comes in contact in the Pontifex machine. On the contrary it has a directly preservative effect, coating the surfaces with a fine protective film or enamel, and doing nothing further. A competitor states that the hot solution of ammonia and water in the Pontifex machine has a corrosive effect on iron. This is absolutely incorrect and erroneous, as indisputably proved by the fact that after working the number of Pontifex machines for so many years no single case has ever been discovered of any corrosion whatever having taken place, and the whole of the Pontifex machines ever made are now at work and as fit for work as when first started. No machine has ever worn out, and, indeed, no limit can be placed upon the duration of these machines.

Safety.—The Pontifex machine consists chiefly of a number of wrought-iron lap-welded coils of pipes, capable of bearing a pressure of several thousand pounds per square inch, placed in very heavy and thick cast-iron vessels, which are designed to bear a strain of over ten times the usual working pressures, and very carefully cast from special brands of pig-iron. The whole apparatus is tested twice to more than three times the ordinary working pressures. It is, therefore, practically impossible for any accident to occur; in proof of which it may be stated that no accident whatever causing danger to or loss of life or limb, or damage to property, has ever occurred with any Pontifex machine.

Foundations.—The Pontifex machine having such very small moving parts requires simply a floor to stand it on which is capable of carrying the weight; the ammonia compression machine requires very large and extensive foundations to take the strain of the heavy moving parts.

In hot climates another advantage of the Pontifex machine comes in with special importance. Where the condensing water is hot the ammonia has to be evaporated and condensed under greater pressure and a higher temperature, and therefore a correspondingly higher steam pressure is required to work the machine. For example, a Pontifex machine working in this country with condensing water at 50° Fahr. would require steam at a pressure of 20 to 30 pounds per square inch; while in the tropics, with condensing water at 85° to 95° Fahr., the steam pressure required would be 40 to 50 pounds per square inch. This means a higher pressure of steam, but only about 10 to 20 per cent. more in quantity to do the work—meaning a coal bill increased by 10 to 20 per cent. But with an ammonia compression machine, as the same amount of gas has to be compressed into a liquid under all conditions of condensing water, and as an increase from 50° to 95° in the initial temperature of the condensing water causes the gas to require nearly double the pressure to condense it, it follows that in the tropics the amount of steam-engine power required to do the same useful work is nearly doubled, which means a coal bill increased nearly 100 per cent.

Chemicals.—A point of minor importance in favor of the Pontifex machine is this: The liquor ammonia used in it is an ordinary commercial article, which can be readily and commonly procured at a cost of 3*d.* to 4*d.* per pound. It is conveyed in ordinary light iron kegs, without trouble or danger. The anhydrous ammonia, used in the am-

monia compression machine, is a special article, only obtainable in this country at one or two places, costing about 3*s.* per pound, and it can only be conveyed in special steel or welded iron tubes under heavy pressure, and can only be transferred from the tubes to the machines by coupling them up together with special pipes, and at some trouble and risk of loss.

The amount of ammonia required to be added after the first charge in the Pontifex machine depends upon the care taken in packing the ammonia pumps. It should not exceed, and in many cases has been found to be less, in value than £3 to £5 per annum.

TABLE OF RESULTS OBTAINED BY THE PONTIFEX MACHINES.

COOLING WATER.

Size of machine.	Ice, equivalent in tons, melted per twenty-four hours.	Gallons of water reduced in temperature 10° Fahr., per hour.	Floor space required.	Power of steam-engine.*	Power of steam-boiler.†	Size of machine.	Ice, equivalent in tons, melted per twenty-four hours.	Gallons of water reduced in temperature 10° Fahr., per hour.	Floor space required.	Power of steam-engine.*	Power of steam-boiler.†
			Ft. *Ft.*	*H. P.*	*H. P.*				*Ft.* *Ft.*	*H. P.*	*H. P.*
A.....	1½	225	10 by 5	1	2	E.....	20	3, 250	20 by 12	4	8
B.....	3	450	12 6	1½	4	E1.....	28	4, 350	22 13	4½	10
C.....	8	1, 200	15 9	2	5	F.....	35	5. 500	22 13	5	12
D.....	14	2, 200	17 10	3	6	G.....	50	8, 000	23 14	6	15
D1.....	17	2, 750	20 12	3½	7						

* It is to be observed that in very many cases existing steam-engines can be made available for supplying the very small amount of engine-power required, the pumps being driven from existing shafting by pulleys and leather belts. In such cases o special steam-ongine is not required.

† These figures denote the horse-power of boiler, which would be supplied with a machine, but much less power would be required if any can be spared from boilers already in use. In such cases all that is required is to run a small steam-pipe from the boilers to the generator of the machine.

The following reduces the above table of quantities of water cooled into the form in which it is most useful to brewers:

Barrels (thirty-six gallons each) of water cooled in twelve hours.

Size of machine.....	A.	B.	C.	D.	D1.	E.	E1.	F.	G.
Ice, equivalent in tons, melted per twenty-four hours	1½	3	8	14	17	20	28	35	50
Degrees Fahr.									
From 50 to 40	75	150	400	733	917	1083	1450	1833	2666
50 45	150	300	800	1466	1834	2166	2900	3666	5332
55 40	50	100	266	488	611	722	966	1222	1777
55 45	75	150	400	733	917	1083	1450	1833	2666
55 50	150	300	800	1466	1834	2166	2900	3666	5332
60 40	37	75	200	366	458	541	725	916	1333
60 45	50	100	266	488	611	722	966	1222	1777
60 50	75	150	400	733	917	1083	1450	1833	2666
60 55	150	300	800	1466	1834	2166	2900	3666	5332
65 40	30	60	160	293	366	433	580	733	1066
65 45	37	75	200	366	458	541	725	916	1333
65 50	50	100	266	488	611	722	966	1222	1777
65 55	75	150	400	733	917	1083	1450	1833	2666
70 40	25	50	133	244	305	361	483	611	888
70 45	30	60	160	293	366	433	580	733	1066
70 50	37	75	200	366	458	541	725	916	1333
70 55	50	100	266	488	611	722	966	1222	1777

COOLING AIR.

Size of machine.	Ice, equivalent in tons, melted per twenty-four hours.	Number of cubic feet of air reduced in temperature 10° Fahr., per hour.	Floor space required.	Power of steam-engine.*	Power of steam-boiler.†	Size of machine.	Ice, equivalent in tons, melted per twenty-four hours.	Number of cubic feet of air reduced in temperature 10° Fahr., per hour.	Floor space required.	Power of steam-engine.*	Power of steam-boiler.†
			Ft. Ft.	*H. P.*	*H. P.*				*Ft. Ft.*	*H. P.*	*H. P.*
A.....	1½	60, 000	10 by 5	1	2	E.....	20	850, 000	20 by 12	4	8
B.....	3	120, 000	12 6	1½	4	E1.....	28	1, 050, 000	22 13	4½	10
C.....	8	250, 000	15 9	2	5	F.....	35	1, 250, 000	22 13	5	12
D.....	14	550, 000	17 10	3	6	G.....	50	1, 900, 000	23 14	6	15
D1.....	17	700, 000	20 12	3½	7						

*It is to be observed that in very many cases existing steam-engines can be made available for supplying the very small amount of engine-power required, the pumps being driven from existing shafting by pulleys and leather belts. In such cases a special steam-engine is not required.

† Care must be taken not to confound the number of cubic feet of air with the cubical contents of the chambers to be cooled. In consequence of the air circulation and the radiation through the roof and walls, etc., the cubical contents of the air in a chamber usually require to be cooled from eight to fifteen times every hour, in order that the temperature of the chamber may assimilate to that of the air passing out from the machine. Circumstances, however, vary so much that no useful rules can be laid down, and in every case a special inspection of the building is desirable.

Only one man is required to work any of the above machines, including stoking the boiler, and for the four smaller sized machines he would have spare time for other work. A man can attend two or more machines if required.

The cooling machines consist of an ammonia machine complete with all the usual connections and fittings, with ammonia pumps fitted on a cast-iron bed-plate and supplied with rods and eccentrics and shaft; or crank-shaft mounted in cast-iron A frames, and provided with pulley ready to be driven by a belt from an existing shaft or engine.

PONTIFEX MACHINES FOR COOLING WATER FOR USE IN REFRIGERATING AND ATTEMPERATING IN BREWERIES.

The most important purpose for which the Pontifex machine can be used in breweries, and that to which it has been most largely applied, is the cooling of the water to be used for refrigerating and attemperating. Where an unlimited supply of well water at 50° to 54° Fahr. temperature can be obtained, a cooling machine becomes of minor importance; but where, as particularly in many large towns, the well water supplies run short or give out, and the brewer has to rely on the town supply as provided by the water company, or on river water, a cooling machine becomes indispensable for the summer production of sound beers, and in many cases for the production of any commercial beers at all.

During the five summer months the town's water usually rises to from 65° to 68° Fahr. or even higher, and it is of course impossible with this to cool the worts down to the usual pitching temperatures of 57° to 59° Fahr. It is also impossible to control the fermentations in the tuns or squares with water of such high temperatures in the attemperators, and, on completion of fermentations, equally impossible to cool the finished beers down to the temperature desirable for racking. Under these circumstances the cooling machine gets the brewer out of all his troubles due to the high temperature of his water supply. The water, at a temperature of 65° or more, as it comes from the company's main or from the brewery water-pump, is run direct through the coil in the cooler of the Pontifex machine, and leaving it reduced to 50°, 45°, or any desired lower temperature, is forced still under its original water company's pressure, and without pumping, to the upper part of the brewery, where, at a height commanding the refrigerators and attemperators, it is discharged into a tank (by preference made of wood, or of iron lagged with wood and sawdust) from which the water is drawn off as required for refrigerating and attemperating.

H is the water-service from the company's main or from well or river water pumps to the cooler of machine. A cock on this pipe is adjusted to pass more or less of the water so that the latter may leave at the desired temperature as shown by a thermometer on the pipe J at the outlet from cooler.

I is the cooled water pipe leading away from the cooler of machine up to—

J, the ice-water tank in which the cooled water is stored to be drawn off as required for refrigerating or attemperating.

The arrangement is simplicity itself. The machine is fixed by preference on the ground-floor near the brewery steam-boilers and placed under the charge of the stoker or engine driver, no special man being required to work it. No special steam-boiler is required, so little steam being wanted that it generally only means the stoker putting on the boiler fire an extra two or three shovelfuls of coals per hour.

In ordinary daily working the machine is started in the morning in time to fill up the ice-water tank by the time the beer refrigerators are started. The machine continues running till the refrigerating is done, and is kept on till the tank is filled up again, leaving a supply of ice-water for the use of the attemperators during the night and until the machine starts again next day. Doubts have been expressed by many brewers as to whether the ice-water would remain cold when left standing in tank during the night and longer. Pontifex and Wood, limited, have therefore made very careful inquiries on this point, and they find that in covered wood tanks, or ordinary iron tanks covered and lagged with wood and sawdust, the rise of temperature has been quite insignificant—not more than 1° Fahr. during from twelve to twenty-four hours.

The practical results in a brewery are, in addition to the improvement in the beer and the complete control obtained over the refrigeration and fermentations, that the beer refrigeration can be done in very much less time and the day's work completed much earlier; and a complete stoppage of the enormous waste of water caused by the necessity to rattle the greatest quantity of the comparatively hot company's water through the refrigerators and attemporators to keep any sort of control of the operations.

It has been found, in most cases, that a saving of more than half the water company's bill for refrigerating and attemperating water has been made.

In large breweries, where great quantities of ice water are required, the machines are generally run continuously day and night. Pontifex machines have been fitted up in the above manner and for the above purpose at sixteen large breweries, the names of and introductions to which will be given upon application.

PONTIFEX MACHINES FOR COOLING THE AIR IN THE FERMENTING AND YEAST ROOMS.

Another very important purpose to which the Pontifex machine has been extensively applied is cooling the air in the fermenting and yeast rooms. Even in those breweries where an unlimited supply of cold water is obtainable it should always be remembered that the water can only be applied—in the fermenting vessels—to cooling the beer itself, and not to the head of yeast above the beer. Therefore, in hot weather, it is not of unfrequent occurrence for the fermenting beers to be well under control by the use of the attemperators, while the yeast above is going wrong, because of the great temperature of the air in the room. Under these circumstances, the Pontifex machine is extremely valuable. It enables the brewer to obtain an October temperature (50° Fahr. or less) at will in the hottest fermenting room and the hottest summer weather.

A circulation of brine (a solution of chloride of calcium in water) is pumped by the brine pump through the coils of pipes in the cooler, and the ammonia gas cools this brine down to somewhere near its own temperature—say about 10° to 20° Fahr. or 22° to 12° of frost, or very much lower, if desired.

From this cooler cold brine flow and return mains are run through the brewery, and up to the top of the building.

In the fermenting rooms rows of cast-iron flanged pipes are fixed over the tuns and squares to be cooled, and through these pipes branch circulations of the cold brine are carried from the brine flow and return mains. This cold brine cools down the pipes to below freezing point, and the surfaces of the pipes cool the air in the rooms down to 45° or 50° Fahr., or any desired temperature. By means of cocks provided on the various branch mains the speed of flow of brine through the various circulations, and consequently the temperature of the rooms can be regulated and reduced or increased at pleasure.

The air in the yeast rooms is cooled in the same manner.

In the simplest arrangement of the brine mains, the whole of the area of the fermenting room is cooled. A separate brine circulation is run over each row of rounds or squares, and all are cooled at once.

In a more elaborate arrangement, where a number of very large squares have to be cooled, the sides and tops of the squares are boxed in with light boarding, and under this boarding the brine pipes are fixed, a separate circulation to each square. This plan enables the temperature of the air over each square to be regulated separately, and the brine to be shut off separately from empty squares; it also economizes the work the machine has to do, as only the air directly over each vessel has to be cooled; but it is most suitable for adoption where the fermenting vessels are very large.

In this case, also, the machine is by preference fixed on the ground floor near the brewery steam-boilers, so that it can be attended to by the existing stoker.

In ordinary working, the machine is run during the day time, and when it is shut off at night and the fermenting rooms are closed up, the large amount of cold stored up in the brine in the pipes over the fermenting vessels is generally found sufficient to keep the rooms down to the desired temperature during the night. In very hot weather, and in very large breweries, however, the machine is generally run at night as well as day.

PONTIFEX MACHINES USED FOR THE COMBINED PURPOSES OF COOLING WATER FOR USE IN REFRIGERATING AND ATTEMPERATING AND COOLING THE AIR IN THE FERMENTING AND YEAST ROOMS.

This is accomplished by one machine in the following manner:

The machine is fitted up with brine pipes in the same way as last described. The fermenting and yeast rooms are cooled by brine pipes in the same way as last described. To cool the water the following plan is adopted, as shown by the illustration on opposite page.

At the top of the brewery building at a height commanding the refrigerators and attemperators, the ice-water tank is fixed. Over this tank is fixed a brass pipe brine refrigerator, consisting of horizontal rows of brass pipes through which a branch circulation of the cold brine from the brine mains is run, while over them the water from the company's mains, at 60° to 65° Fahr. or any other temperature is allowed to trickle, and in so doing it is cooled by the brine inside the pipes, and after cooling runs into the cold-water tank from which it is drawn through the pipes and as required for refrigerating and attemperating. By this arrangement the water can be cooled down to 33° Fahr. or any desired temperature above that.

On this plan by simply opening, shutting or regulating cocks, the whole or any desired proportion of the power of the Pontifex machine can be applied to cooling air or to cooling water, or both at the same time, according to the requirements of the brewery; and with the apparatus so arranged brewing can be conducted in the hottest weather with the same facility, certainty, safety, and convenience as in the autumn or winter.

COOLING THE AIR IN LAGER BEER FERMENTING ROOMS AND STORE CELLARS.

The illustration on the opposite page shows the method of cooling lager beer fermenting rooms and store cellars. The plan here adopted is similar to that for cooling

the air in fermenting and yeast rooms, with the differences that the temperature required being lower (about freezing point), larger quantities of brine pipes, and in some cases wrought-iron brine pipes of smaller diameter are provided.

APPLICATION OF THE MACHINES TO THE MANUFACTURE OF ICE IN ADDITION TO THEIR ORDINARY WORK.

It is frequently desired in breweries to make a small quantity of ice, either for use in keeping yeast cool, or to send out to public houses, or for private use.

When machines have a brine circulation this is very easily accomplished. If opaque ice will do, it is only necessary to place in the brine-tank galvanized iron pails or molds made of the shape of which the blocks of ice are required. These molds being filled with water and suspended in the brine-tank are, in a few hours, frozen by the brine outside into solid blocks of ice. The molds are then lifted out and turned upside down, when the ice-blocks drop out, the molds being made taper to allow of this.

When clear ice is required it is necessary to keep the water in motion while freezing, and then a more complete arrangement is required, called a patent pyramid ice-box. The illustration on the page opposite 16 shows this.

This shows a small special brine-tank made of wrought iron and lagged with wood and filled in with sawdust. A small branch brine-pipe with regulating cock—taken off the brine main from cooler—runs into one end of this brine-tank, and the warmed brine overflows from the other end of it running into the ordinary brine-tank. In this special brine-tank a number of ice-molds made of galvanized wrought iron and of pyramidal form are placed. Each of these molds is provided with a spiral agitator or endless screw, which being kept constantly revolving, keeps the water in process of freezing in motion. The agitators are kept revolving by means of a countershaft and pulleys driven by a gut band from the nearest convenient shafting. When freezing is finished the agitator is taken off and the mold lifted out and turned upside down, when a beautiful, clear, crystal pyramid of ice, as shown on illustration, appears. As the center of the mold freezes up last, freezing can be stopped at any point, and the hollow left in the block filled in with flowers, fruit, lobsters, etc., which can then be frozen up in the block.

When machines have no brine circulation, but are used for cooling water direct, the same pyramid ice-box is used. In this case, however, as there is no brine circulation, a coil of iron pipes is placed in the ice-box brine-tank, through which ammonia from the cooler is allowed to circulate, expanding in doing so into a gas, and so producing the necessary cold.

When larger quantities of ice are required, it is desirable that the refrigerating machine should be specially arranged accordingly and provided with either "cell," "wall," or "can" ice-boxes.

COST OF WORKING.

The cost of working a given size of refrigerating machine, whether used for cooling water or air or both, is approximately the same. It is about as follows per day of twelve hours.

	A	B	C	D	D1	E	E1	F	G
Quantity of coal used, about cwt.	2	3	4	5	5½	6	8	10	12
	s. *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
At 10*s.* per ton	1 0	1 6	2 0	2 6	2 9	3 0	4 0	5 0	6 0
Ammonia to replace loss, say	0 3	0 3	0 3	0 6	0 6	0 6	0 9	0 9	0 9
Oil, say	0 3	0 3	0 3	0 6	0 6	0 6	0 6	0 6	0 9
Total	1 6	2 0	2 6	3 6	3 9	4 0	5 3	6 3	7 6
If coals cost 15*s.* per ton add to above totals	0 6	0 9	1 0	1 3	1 5	1 6	2 0	2 6	3 0
If coals cost 20*s.* per ton add to above totals	1 0	1 6	2 0	2 6	2 9	3 0	4 0	5 0	6 0

The above are practical working figures where ordinary care is taken. No doubt with good coal and skillful firing and care in working the coal consumption can be reduced, but these conditions seldom exist. When a machine runs continuously for a long time at much less than full power—as in cooling rooms—the coal consumption is proportionately reduced.

The existing engine driver or stoker is assumed to be taking charge of the machine. Of course if a special man is provided his wages, say 3*s.* 6*d.* to 4*s.* per day, be added.

Nothing is put down for condensing water, as the coal consumption is sufficient to include the steam power required to pump it from surface or a moderate depth, and it is assumed that the water itself is provided.

Depreciation and interest on capital—each usually taken at 5 per cent.—every purchaser will calculate on his usual system.

PONTIFEX MACHINES FOR ICE-MAKING.

Table of results obtained by the Pontifex machines.

Size of machine.	Ice made in 24 hours.	Ice equivalent in tons melted per 24 hours.	Coal consumed per hour.	Space required.	Power of steam-engine.	Power of boiler.	Size of machine.	Ice made in 24 hours.	Ice equivalent in tons melted per 24 hours.	Coal consumed per hour.	Space required.	Power of steam-engine.	Power of boiler.
	Tons.	*Tons.*	*Pounds.*	*Feet.*	*H. P.*	*H. P.*		*Tons.*	*Tons.*	*Pounds.*	*Feet.*	*H. P.*	*H. P.*
B.....	1½	3	27	25×20	2	5	E ...	9	20	80	55×35	5	10
C.....	4	8	48	35×25	3	6	E1 ..	12	28	100	70×40	5½	12
D	6	14	65	46×30	4	8	F....	15	35	120	70×40	6	15
D1 ...	7½	17	72	55×35	4½	9	G ...	24	50	165	90×50	7	20

Ice-making machines are invariably required to run night and day, and the staff of men required to work them is usually about as follows:

Size of machine.	Engine driver or stoker, day.	Engine driver or stoker, night.	*Laborers to remove ice, day.	Total number of men required.	Size of machine.	Engine driver or stoker, day.	Engine driver or stoker, night.	*Laborers to remove ice, day.	Total number of men required.
A, B or C	1	1	1	3	E1 and F	1	1	3	5
D, D1, and E....	1	1	2	4	G	1	1	4	6

The ice-making machines consist of an ammonia machine complete, with steam engine and boiler, patent ice-boxes, with agitators and fittings capable of making perfectly clear, transparent ice; ammonia, brine relieving, boiler feed and condensing water pumps with driving gear; hot and cold brine tanks, shafting, riggers, and belts, and all brine and steam pipes between the various parts of the apparatus.

The Pontifex machine when applied to ice-making is similar to that used in breweries.

In addition, however, to the machine itself, ice-boxes are required in which to freeze the water into ice. These are made on different plans, as follows:

ICE-MACHINES WITH CAN BOXES.

The can box consists of a wrought or cast iron tank of large size, lagged with wood filled in with sawdust. This tank is filled with brine. A circulation of brine (a so-

* The number of laborers varies according to the class of men available and the facilities for removing, storing, and loading the ice. In hot climates, where black labor has to be employed, many more men are required.

lution of chloride of calcium in water) is pumped by the brine-pump through the coils of pipes in the cooler, and the ammonia gas cools this brine down to somewhere near its own temperature, which varies according to the thickness of the ice being made from 15° Fah. (above zero) to minus 10° (below zero) Fah. or lower. From this cooler a cold brine-pipe is run into one end of the brine-tank. From the other end of the brine-tank a warm brine-pipe is run back to the brine-pump, which continually draws brine away from the brine-tank as fast as it delivers it into the cooler, and so keeps up a constant circulation.

In the brine-tank galvanized iron ice-molds are placed. These are filled with water, and provided with agitators. These agitators are wood blades mounted in frames above the ice-molds, and being continually reciprocated by means of the steam-engine they keep the water in the molds in motion, which causes it to freeze up into clear ice. When freezing is completed the agitators are removed, and the ice-molds, being lifted out by means of the traveler, are carried horizontally to the relieving-tank (which is filled with part of the warm water running waste from the absorber) and dipped therein for a few seconds. The molds are then drawn out and reversed, when the block of ice drops out; and the mold is then filled with water and returned into the brine-tank and commences refreezing.

On this system of making ice the cans are each made of such a size as to produce a rectangular block of ice of given weight. For example:

Blocks weighing 1 cwt. each are made in cans 2 feet × 2 feet × 6 inches thick. Blocks weighing 1½ cwt. each are made in cans 2 feet 6 inches × 2 feet 6 inches × 6 inches thick. Blocks weighing 2 cwt. each are made in cans 2 feet 6 inches × 2 feet 6 inches × 8 inches thick. Blocks weighing 3 cwt. each are made in cans 3 feet × 3 feet × 8 inches thick. Blocks weighing 4 cwt. each are made in cans 3 feet 6 inches × 3 feet 6 inches × 8 inches thick. Blocks weighing 6 cwt. each are made in cans 3 feet 6 inches × 3 feet 6 inches × 12 inches thick, or larger or of altered proportions as desired.

This is the oldest and simplest plan of making ice, and has many advantages:

(1) The first cost of an ice plant is considerably lessened.

(2) Where opaque ice is all that is required, it is not necessary to keep the water in motion, and agitators can be dispensed with.

(3) The blocks are produced of a uniform given size and weight, convenient to load and pack, and no weighing is necessary.

(4) If a can leaks it can be immediately placed on one side for repair, and a spare one takes its place without delay or any partial stoppage of the apparatus.

(5) The whole of the parts of the ice-box are very simple, and can be repaired or remade by any ordinary engineer without special knowledge of ice machinery.

On the other hand there are certain objections:

(1) The agitator blade occupies the middle of the can while the block is freezing, and as the ice freezes up it closes round this; to prevent it freezing in, the agitator has to be withdrawn and the space occupied by it in its traverse frozen up without agitation. Consequently each block has a narrow core of semi-transparent or almost opaque ice in the center. This, however, is only of slight disadvantage in appearance, and even this disadvantage disappears when the ice is broken up. Nor does it affect the keeping qualities of the ice.

(2) If there are any impurities in the water they are frozen up in the ice and tend to show to some extent in the center of the block.

(3) The blocks sometimes freeze up at different speeds, and it therefore may happen that, through carelessness in watching, some agitators get frozen in prematurely, causing their breakage.

(4) The cans, from having constant handling, sometimes leak and so cause a charge for repairs.

(5) Every time a block of ice is lifted out of the brine tank the can has to be lifted and handled with it, and there is a greater weight to handle over what there would

be if the ice only had to be dealt with. This and the extra handling of the empty cans may cause this plan to require a slight amount of extra labor.

(6) By carelessness water may be spilled or leaked into the brine, weakening it.

To reduce or obviate objections Nos. 1 and 2 a plan has been devised of placing a wood frame in the middle of the mould and letting the agitator work inside it—a block being frozen up at each end. This acts so far satisfactorily, but causes new difficulties. The wood freezes to the ice and has to be drawn out of the mold with it and removed by chisels and replaced in the mold; and a certain amount of dirty water has to be pumped out of each mold before removal of the ice, thus causing more hand-labor. In consequence, also, of the blocks freezing up at unusual speeds, some often come out of uneven shape, with a large hole in the center and of much less than the full weight.

To reduce objection No. 5, which is a very important one, various ingenious and complicated arrangements for handling a number of molds together with the assistance of steam-power have been devised. These have been more or less successful, but are evidently only imperfect attempts to overcome difficulties which do not exist in other plans of making ice.

ICE-MACHINE WITH BOXES ON THE WALL SYSTEM.

On this plan an ice-plant has two or more boxes. Thus a 2 or 4 ton plant has two boxes; a 6-ton, two or three boxes; a 9-ton, three boxes; a 15-ton, four or five boxes; and a 24-ton, eight to ten boxes.

The Wall box consists of a wood or wrought-iron water-tank. If made of iron, it is lagged with wood filled in with sawdust. In this tank a number of vertical galvanized cast-iron hollow walls or partitions are fixed by means of bolts to hollow cast-iron ends. Through these walls a circulation of brine cooled by the refrigerating machine is pumped by the brine-pump through the cold-brine pipe. The tank is filled with water, which, being cooled by the brine, freezes on to the hollow walls. The brine, warmed by passing through the walls and freezing the water, goes away to the cold brine tank, from which the brine-pump draws it and forces it through the cooler of the machine, where, being cooled, it again passes to the Wall box and so completes its circuit, the circulation being continuous until the ice has finished freezing. To keep the water in motion agitators reciprocate between the walls as shown, these being driven by means of shafting by the steam-engine, which also drives the ammonia, brine, and water pumps. The hollow walls reach nearly to the bottom of the tank, being kept a few inches above it, and in the space left all impurities voided by the water in freezing settle.

The brine-pipes to the wall boxes are provided with cocks so arranged that when freezing is finished (which is accomplished when the ice has grown to within about ¼-inch clear of the agitator) the brine can be shut off from the box (and turned on to others). The cold brine is then drained out of the walls into the cold-brine tank. There is a small warm-brine tank in which a reserve of brine, heated by means of a coil of steam-pipes by the exhaust steam of the engine or other means, is kept ready. This brine is forced by means of the small warm-brine pipes through the hollow walls of the wall-box, so melting the ice off, and leaving it ready for removal. The agitators are then lifted out. The ice-blocks so made are usually 14 feet long, 3 feet deep, and 6 to 10 inches thick. By means of a saw they are in the box cut into conveniently-sized blocks, say 3 feet 6 inches, by 3 feet, by 6 inches to 10 inches thick, and floating in the surplus water, are lifted out by the overhead traveler straight from the wall-box, and dropped into the cart standing ready to receive them, or dragged away to the store. The surplus water in the box is then filled up to the original level, the agitators are replaced, the warm-brine is shut off and drained out, the cold-brine turned on, and freezing commences. About once a week the water is all run out and the dirt at bottom of the wall-box washed out. Ice made on this plan is far superior to the best natural ice, being of much greater purity, and of the most attractive bril-

liant crystal clear appearance; and it can not be equalled by any other system of manufacture. Where purity and appearance are of great importance, as for restaurants, clubs, hospital, etc., this ice is always preferred to any other and fetches a higher price. The only objection to it is that it can not be obtained in blocks of uniform size and weight, without cutting up to shape, entailing waste and labor.

The advantages of this plan are :—

(1) Superior purity and appearance of the ice made.

(2) Scarcely any liability to breakage of agitators.

(3) No cans to handle or repair. The walls being fixed and of strong galvanized cast-iron are practically indestructible.

(4) Only the actual ice itself has to be handled, so much less weight has to be moved in comparison with the can system.

(5) When an ice box is finished it can be shut off by simply turning the cocks, and left till it is convenient to remove the ice. Thus all the boxes can be set so as to be completed during the day, and no night-shift of laborers is required.

(6) The water can not spill or leak into the brine and so weaken it.

The objections to this plan are :—

(1) The ice can not be produced in blocks of a given size and weight without waste and labor.

(2) If a box requires repairs it has to be shut off and the capacity of the machine is temporarily reduced in proportion. Repairs, however, are scarcely ever required; the shutting off is accomplished by simply turning cocks; and in a large machine the temporary proportionate reduction of capacity through a box being shut off for repairs is only from 10 to 20 per cent.

To remedy the objection No. 1, and to enable thicker ice to be made in a given time, Pontifex & Wood, limited, have designed their patent cell-box, which is next described.

ICE-MACHINE WITH PATENT CELL ICE-BOXES.

On this plan an ice plant has (as on the wall system) two or more boxes. Thus a 2 or 4-ton plant has 2 boxes, a 6-ton two or three boxes, a 9-ton three boxes, a 15-ton three or four boxes, and a 24-ton six to eight boxes.

The illustration opposite shows an ice plant to make 15 tons of ice per twenty-four hours, and provided with four-cell ice boxes. Opposite page twenty-two will also be found an illustration in detail to a larger scale of the patent cell ice-box. The cell ice-box consists of a wood or wrought-iron water tank. If made of iron it is lagged with wood filled in with sawdust. This tank is provided with (1) a galvanized wrought-iron hollow or double bottom; (2) two galvanized cast-iron hollow cross walls, or partitions; and (3) a number of short galvanized cast-iron longitudinal hollow walls fixed at right angles to the cross walls. Between the end of the tank and the ends of the longitudinal walls, open spaces are left. Each of these longitudinal walls is 3 feet 6 inches by 3 feet 6 inches, and they are fixed at a distance apart equal to the thickness of the blocks of ice it is desired to make, usually 9, 10, or 12 inches. Between each two of these longitudinal walls the ice forms, and therefore the blocks made are either: Three feet 6 inches by 3 feet 6 inches by 9 inches thick, weighing about 4½ hundred weight each, or 3 feet 6 inches by 3 feet 6 inches by 10 inches thick, weighing about 5 hundred weight each, or 3 feet 6 inches by 3 feet 6 inches by 12 inches thick, weighing about 6 hundred weight each.

Blocks have also been made 3 feet 6 inches by 3 feet 6 inches by 15 inches thick, weighing 7½ hundredweight each, and even of 3 feet 6 inches by 3 feet 6 inches by 1 foot 9 inches thick, weighing 10½ hundredweight each; but these extremely thick blocks are not recommended commercially as they take such a long time to freeze up. Through the double bottom, cross-walls, and longitudinal walls, a circulation of brine cooled by the refrigerating machine is pumped by the brine pump H through the cold brine pipe I. The tank is filled with water, which being cooled by the brine freezes

on to the double-bottom, cross and longitudinal walls. The brine, warmed by passing through the bottom and walls and freezing the water, goes away to the cold brine tank from which the brine pump H draws it and forces it through the cooler D of the machine, where being cooled it again passes to the cell box and so completes its circuit, the circulation being continuous until the ice is finished freezing. The two layers of ice gradually growing thicker between each two longitudinal walls at last meet and freeze together, when the block is finished. To keep the water in motion agitators reciprocate in the open spaces as shown, these being driven by means of shafting by the steam-engine, which also drives the ammonia, brine, and water pumps. The agitators in moving give an impulse to the water, causing it to rush in a wave between the longitudinal walls, and washing out all the impurities voided by the water in freezing, which settle at the bottom of the open spaces.

The brine-pipes to the cell boxes are provided with cocks so arranged that when freezing is finished the brine can be shut off from the box and turned on to others. The cold brine is then drained out of the double bottom and walls into the cold brine tank. There is a small warm brine tank in which a reserve of brine, heated by means of a steam coil of pipes by the exhaust steam of the engine or other means, is kept ready. This brine is forced by means of the small warm brine pump through the hollow double bottom and walls of the cell-box, so melting the ice-blocks off and leaving them ready for removal. The agitators are than lifted out. The ice-blocks are gently started away from the cross-walls to enable the ice-grips to grasp each end, and are lifted straight out by the overhead traveler P and dropped into the cart standing ready to receive them, or dragged way to the store. The surplus water in the box is then filled up to the original level, the agitators are replaced, the warm brine is shut off and drained out, and cold brine turned on, and freezing recommences. About once a week the water is all run out and the dirt at bottom of the cell-box washed out.

The ice turned out on this plan of cell-boxes is far superior to the best natural ice, being of far greater purity, clearness, and brilliancy, and produced in blocks of the most convenient form for commercial purposes.

The advantages of this plan are—

(1) The blocks are produced of a uniform size and weight, convenient to load and pack; and no weighing is necessary.

(2) The ice is of superior purity and appearance, and of great thickness.

(3) No liability to breakage of agitators.

(4) No cans to handle or repair. The walls are fixed and the general arrangement is of very great strength and practically indestructible.

(5) Only the actual ice itself has to be handled, so less weight has to be in comparison to the can system.

(6) No cutting up waste or weighing of ice, as in the Wall system.

(7) When an ice-box is finished it can be shut off by simply turning the cocks, and left till it is convenient to remove the ice. Thus all the boxes can be set so as to be completed during the day, and no night shift of laborers is required.

(8) The water can not spill or leak into the brine and so weaken it.

The only objection, if it can be called an objection, to the cell-box system, is that if a box requires repair it has to be shut off, and the capacity of the machine is temporarily reduced in proportion. Repairs, however, are scarcely ever required; the shutting off is accomplished by simply turning cocks; and in a large machine the temporary proportionate reduction of capacity through a box being shut off for repairs is only from 10 to 20 per cent.

COST OF WORKING AND PRODUCING THE ICE.

The cost of working varies considerably in different sized plants, working under different conditions; but Pontifex & Wood, limited, are prepared to guarantee, when required, that 15 and 24 ton plants shall be capable of producing in this country the

best clear ice at a cost not exceeding 5*s*. per ton; the cost being for labor, coals, oil, chemicals, and water for making the ice.

The following are approximate estimates of the cost of working:

G or 24-ton ice-plant.

Per week of six days:	£	*s*.
Coal, 12 tons, at 10*s*. per ton	6	0
Ammonia, to replace any leakage, say	0	6
Oil, say	0	4
Water to make ice of, adding 50 per cent. for waste, 50,000 gallons, at 6*d*. per 1,000	1	5
Wages, day engineer	1	15
Wages, day, four laborers to remove ice, at 20*s*.	4	0
Wages, night stoker	1	5
	14	15
£14 by 24=144 tons of ice made=2*s*. ¾*d*. per ton of ice; if coal costs 20*s*. per ton add	6	0
=2*s*. 10½*d*. per ton of ice	20	15

F or 15-ton ice-plant.

Per week of six days:	£	*s*.
Coal, 9-tons, at 10*s*. per ton	4	10
Ammonia, to replace any leakage, say	0	6
Oil, say	0	4
Water to make ice of, adding 50 per cent. for waste, 36,000 gallons at 6*d*. per 1,000	0	18
Wages, day engineer	1	15
Wages, day, three laborers to remove ice, at 20*s*	3	0
Wages, night stoker	1	5
	11	18
6×15=90-tons of ice made=2*s*. 7½*d*. per ton of ice. If coals cost 20*s*. per ton, add	4	10
=3*s*. 7½*d*. per ton of ice	16	8

C or 4-ton ice-plant.

Per week of six days:	£	*s*.
Coal, 3 tons, at 10*s*. per ton	1	10
Ammonia, to replace any leakage, say	0	3
Oil, say	0	2
Water to make ice of, adding 50 per cent. for waste, 10,000 gallons at 6*d*. per 1,000	0	5
Wages, day engineer	1	15
Wages, day laborer to remove ice	1	0
Wages, night stoker	1	5
	6	0
6×4=24 tons of ice made=5*s*. per ton of ice. If coals cost 10*s*. per ton, add	1	10
=6*s*. 3*d*. per ton of ice	7	10

With the above figures, and a knowledge of the local cost of coals and labor, each intending purchaser will be able to calculate for himself the approximate cost of producing ice in his neighborhood. To the above figures depreciation and interest on capital, usually each calculated at 5 per cent. per annum, have to be added. It will be observed that the cost of producing small quantities of ice is, as might be expected, relatively very much higher than of producing large quantities.

In hot climates, as India, etc., the machines usually fall off in their production of ice from 10 to 30 per cent., while the cost of working remains the same or becomes higher, but no fixed rules can be laid down for this.

PROVISION COOLING STORES.

Pontifex & Wood desire to draw attention to the gain to be made by securing an additional source of income to an ice plant by providing in conjunction therewith cold stores for the use of butchers, poulterers, fish-mongers and others. These stores can be very simply cooled by a small proportion of the power of the ice-machine, and worked by the same staff.

PONTIFEX REFRIGERATING MACHINES FOR ARTIFICIAL BUTTER MANUFACTORIES.

In this manufacture the various ingredients, after being melted and mixed together at about blood heat in churns, are mixed with and run out into ice-cold water contained in open troughs; the sudden application of the intense cold crystallizing and granulating the artificial butter, which is skimmed off; and the water at the same time washing out the butter milk, which would taint the butter by its rapid decomposition. Originally and still to a large extent ice is used for the production of the ice-cold water, ice being placed in tanks filled with water, and melting, the former imparts its cold to the latter. The objections to this plan are the great cost of the ice and of handling it, the impossibility of getting as low a temperature as desirable (because the best result obtainable by this process is the mean of the two temperatures of the ice and water); the impossibility of obtaining an exact regular temperature continuously, and the fact that the ice being always more or less dirty renders the water so, and so soils the artificial butter and spoils its appearance.

The Pontifex machine overcomes these difficulties. Its cost of working is so small that an amount of cold equal to that produced by the melting of a ton of ice is obtained at a working cost of less than 1*s.*; from the moment it starts to work a continuous stream of ice-cold water of a steady even temperature as low as 32½° Fahr. (or ½° Centigrade), if desired, is available; and the water coming in contact with nothing but the copper or brass tubes of the brine refrigerator leaves the machine as clean as it enters.

The machine itself has been previously described. A circulation of brine is pumped by the brine pump through the coils of pipes in the cooler and the ammonia gas cools this brine down to about 20° Fahr. In the churn room over the churns, or in any other convenient position, the ice water tank is fixed. Over this tank is fixed a patent copper or brass pipe brine refrigerator, consisting of horizontal rows of copper or brass pipes through which the circulation of cold brine is run, while over them the water to be cooled coming from the water company's mains at 55° to 65° Fahr. or any other temperature, is allowed to trickle, and in so doing it is cooled down to 32½° or 33° Fahr. by the brine inside the pipes, and after cooling runs into the ice water tank M, from which it is drawn as required for the use of the churns. The brine refrigerator is shown to a larger scale on the opposite page.

Some artificial butter makers are now using water cooled down only to 39° or 40° Fahr. In these cases the brine refrigerator is not required, the water to be cooled being simply run through the pipes in the cooler as in breweries.

The following is a table of the approximate quantities of water cooled by the Pontifix machine.

[In gallons per hour.]

Size of machines.	B.	C.	D.	D 1.	E.	E 1.	F.	G.
Ice equivalent in tons melted per 24 hours	3	8	14	17	20	28	35	50
Fahrenheit.								
From 73 to 33	100	270	500	620	730	980	1,240	1,800
" 68 to 33	115	310	570	700	835	1,115	1,410	2,050
" 63 to 33	135	360	660	825	975	1,300	1,650	2,400
" 58 to 33	160	430	790	990	1,170	1,565	1,980	2,880
" 53 to 33	100	540	990	1,140	1,460	1,950	2,475	3,600
" 48 to 33	270	720	1,320	1,650	1,950	2,610	3,300	4,800
" 70 to 40	150	400	730	920	1,080	1,450	1,830	2,660
" 65 to 40	180	480	880	1,100	1,300	1,740	2,200	3,200
" 60 to 40	225	600	1,100	1,375	1,625	2,175	2,750	4,000
" 55 to 40	300	800	1,465	1,030	2,165	2,900	3,660	5,330
" 50 to 40	450	1,200	2,200	2,750	3,250	4,350	5,500	8,000

The following is an almost similar table reduced to the metric system.

[In liters per hour.]

Size of machines	B,	C.	D.	D 1.	E.	E 1.	F.	G.
Centigrade.								
From 24 to 1	445	1,186	2,173	2,692	3,211	4,259	5,434	7,905
" 21 to 1	511	1,363	2,500	3,097	3,693	4,899	6,249	9,090
" 18 to 1	602	1,604	2,941	3,643	4,345	5,763	7,352	10,694
" 15 to 1	730	1,948	3,571	4,424	5,276	6,998	8,928	12,986
" 12 to 1	929	2,479	4,541	5,630	6,715	8,907	11,363	16,528
" 9 to 1	1,278	3,409	6,250	7,742	9,233	12,247	15,624	22,727
" 22 to 5	668	1,782	3,268	4,048	4,822	6,404	8,169	11,883
" 19 to 5	811	2,164	3,968	4,915	5,862	7,775	9,920	14,429
" 16 to 5	1,033	2,754	5,050	6,256	7,461	9,896	12,626	18,364
" 12 to 5	1,623	4,328	7,936	9,831	11,724	15,551	19,841	28,859
" 11 to 5	1,934	5,050	9,259	11,469	13,678	18,143	23,147	33,366

PONTIFEX MACHINES FOR PARAFFIN OIL WORKS.

The Pontifex machine is specially advantageous for this purpose, not only on account of the great economy of the process, but particularly because the very low temperatures which can be maintained by it enable refiners to extract in the presses a far larger quantity of the valuable paraffin than can be obtained in any other way, and the quality of the oil separated is at the same time much improved.

Until recently ether machines have been largely used for this purpose, but the great difficulty with which by their use sufficiently low temperatures are obtained, and their very great reduction of sufficiency at these low temperatures, has caused them to be discarded in almost every case in favor of the Pontifex machine.

The illustration on the opposite page shows the most usual application of the Pontifex machine for paraffin oil cooling. The machine itself has been previously described. A circulation of brine is pumped by the brine pump through the coils of pipes in the cooler, and the ammonia gas cools this brine down to about zero, to 5° below zero Fahrenheit, or lower if desired. In an adjoining room are placed the cooling drums. Each drum consists of an open shallow trough in which revolves a hollow cast-iron or copper cylinder or drum. The oil to be cooled is placed in the trough. The surface of the drum in its revolution dips into this oil and becomes coated with a thin film of it, and is cooled by the circulation of cold brine from the machine, which is run through the drum by means of trunions with stuffing boxes at the ends. As the drum continues its revolution, the cooled oil is reduced to the temperature of 10° or 12° Fahrenheit, or to any other desired, and, in a pasty condition, is removed by a scraper, pressed against the side of the drum. The oil is then drawn away by plunger pumps and forced through filter presses which separate the paraffin wax crystals or scales from the oil.

In a new and improved apparatus the oil to be cooled is placed in large tanks provided with a number of vertical iron hollow walls or divisions. Through these hollow walls the circulation of brine is pumped, cooling down the oil in the spaces or chambers between them. After cooling, the oil is drawn away from the chambers by pumps and filtered as before. This plan is considered superior for several reasons, but chiefly because the oil having a much longer time to cool, the paraffin crystals or scales are formed very much larger, thus enabling the oil to be filtered more readily, and producing a larger quantity and better quality of wax and a better quality of oil.

PONTIFEX MACHINES FOR CHEMICAL WORKS.

Pontifex machines have been supplied to several chemical works, where they have been used chiefly for the reduction of mother liquors to low temperatures to increase the speed of crystallization, and the quantity of crystals produced. Also for the freezing of various chemicals and other purposes. The cold produced by the machine is usually imparted to a brine circulation which is used as a medium for reducing the temperature of the article to be cooled.

PONTIFEX MACHINES FOR BACON-CURING WORKS.

The Pontifex machines have been largely erected in bacon-curing factories, and their use in such is considered one of their most successful applications.

Originally the pigs after being killed were cooled simply by exposure to the atmospheric air, and afterwards cured in underground cellars at the temperature of the earth or 52° to 55° Fahr. These temperatures not being sufficiently low allowed of rapid decomposition and consequent taint in the bacon. To reduce this as far as possible, the bacon was charged with an excessive and objectionable amount of salt to preserve it. The public taste having latterly always moved in the direction of more and more mildly cured bacon, necessitated the artificial reduction of the temperature of the chill rooms and curing cellars. This has been usually accomplished by making the cellars with iron ceilings, above which were stored vast quantities—amounting in some cases to even thousands of tons of ice. This system was found very effective and is still largely in use; but it has many objections, of which the chief are (1) the large first cost of and amount of space occupied by the ice chambers, iron ceilings and their supports; (2) the great and continually recurring cost of the ice itself; (3) the cost and inconvenience of handling the ice; (4) the great risks ran and losses incurred when by any chance in the hot weather the supplies run short, and (5) the fact that the moisture rising in the air condenses against the underside of the iron ceiling and drips down on the bacon in process of curing.

The Pontifex system removes all these objections, and its application is so simple, powerful, and economical, and has proved in every respect so perfectly successful, that its universal adoption by the bacon trade in the United Kingdom is only a question of a very little time.

The illustration herewith shows the manner in which the Pontifex machine is applied in bacon factories. A circulation of brine (a solution of chloride of calciumin water) is pumped by the brine pump through the coils of pipes in the cooler and the ammonia gas cools this brine down to somewhere near its own temperature—say about 10° to 20° Fahr. or 22° to 12° of frost, or very much lower if desired. From this cooler cold brine flow and return mains are run through the factory to the chambers to be cooled. In the chill rooms and curing cellars rows of cast-iron flanged pipes are fixed overhead over the whole area, hanging from the ceiling; and through these pipes branch circulations of the cold brine are carried from the brine flow and return mains. This cold brine cools down the pipes to below freezing point, and the surfaces of the pipes cool the air in the rooms down to 40° Fahr., or any desired temperature. By means of cocks provided on the various branch mains, the speed of flow of brine through the various circulations, and consequently the temper-

ature of the rooms can be regulated and reduced or increased at pleasure. In ordinary working the machine is run in the day-time; and when it is stopped at night and on Sunday, and the curing cellars, etc., are closed up, the large amount of cold stored up in the brine in the pipes is generally found sufficient to keep the rooms down to the desired temperature until next morning. In very hot weather and in very large bacon factories the machine is generally run at night as well as day.

The chill or cooling rooms and the curing cellars are fitted up in the same manner; the only difference being that in the chill or cooling rooms, where the work to be done in cooling down the hot meat is greater in proportion to their size but intermittent, a proportionately larger number of brine pipes are placed, and the brine is turned on or off as the rooms are full or empty; while in the curing cellars, where the work to be done in proportion to their size is less but regular, a proportionately less number of brine pipes are placed, and the brine is always kept in circulation while the machine is running, maintaining a steady and perfectly even temperature.

The machine is fixed by preference on the ground floor near the the factory steam-boiler, and placed under the charge of the regular stoker or engine driver, so that excepting where there is more than one machine no special man is required to work it. No special steam-boiler is required, so little steam being wanted that it generally only means the stoker putting on the boiler fire an extra two or three shovelfuls of coal per hour.

The approximate cost of running the machines will be found to be usually actually less than ice if the latter could be bought at 1*s.* per ton. Thus an E machine doing the same amount of work as the melting of 10 tons of ice per twelve hours, costs 7*s.* per twelve hours to run; and a D machine doing the same amount of work as the melting of 7 tons of ice per twelve hours, costs 6*s.* per twelve hours to run; and these costs are only reached when coal costs as much as 20*s.* per ton.

No insulation or other preparation of the cooling or chill rooms or curing cellars is necessary; the chambers being taken just as they are and the brine pipes fitted up in sections without stopping the ordinary work.

In some factories the machines have been applied to cooling the curing cellars alone, leaving the chill or cooling rooms to be cooled by cold-air machines.

PONTIFEX MACHINES FOR COOLING STORES, AND FOR PRESERVING MEAT, FISH, FRUIT, ETC.

This has become a very important trade, and the Pontifex machine is particularly suited for the purpose.

A chamber of any required size can be kept at a uniform temperature of say 30° to 40° Fahr. (which is found to be the best temperature for preserving food), at a very small cost.

The great amount of labor and the considerable expense which the use of ice entails is thus avoided, as is the injury done to the keeping properties of food when it comes in contact with either ice or moist atmosphere.

By the Pontifex process a perfectly dry atmosphere can be obtained with the greatest facility, or, on the other hand, when fish, for instance, is to be stored which is injured by too dry an atmosphere the natural moisture can be retained by a simple modification of the arrangements.

The chambers can, if desired, be kept at a temperature as low as 30° or 40° below freezing, but for most descriptions of food it is found injurious to expose it to a temperature low enough to freeze, and thus burst the vesicles of which flesh, etc., is constructed.

Until lately cold-air machines have been used almost exclusively for the purpose of freezing and keeping meat frozen, but in consequence of the enormous cost of producing the cold, which requires quite fifteen to twenty times as much steam power and coals as the Pontifex machine to produce the same result, with a proportionately large extra charge for labor working the machines, oil, etc., the Pontifex machines are

now superseding the cold-air machines, on land where they are appliable. The Pontifex machines can not be used on shipboard, as they would not work properly if fixed on an unstable foundation.

The machine itself and its general arrangements are similar to those already described for bacon-curing works, with this alteration, that where exceedingly low temperatures are required as in the cases of stores for actually freezing meat and keeping it frozen, it is usually found desirable to fit up small wrought instead of large cast iron brine mains, as with the former the cold of the brine is more readily conducted through the thin metal of the pipes into the rooms.

PONTIFEX MACHINES FOR DISTILLERS.

These machines will be found of great value in hot weather to distillers, by keeping the spirit in the store tanks cool, thus effecting a great saving by avoiding the very considerable loss which occurs by evaporation.

PONTIFEX MACHINES FOR YEAST MERCHANTS.

The importance of the process to this trade is very large; the injury done to yeast and the disease set up in it by temperatures even only moderately warm, is well known. In consequence of this fact, the price in the market of German yeast rises fully 50 per cent. in warm weather.

PONTIFEX MACHINES FOR CHOCOLATE MANUFACTURERS.

For this purpose great advantages will be found by the use of this machine.

The cooling-room can be kept at a low temperature, and much waste saved by the rapid solidification which it renders possible, and also by the great advantage that the chocolate comes readily and perfect in shape out of the molds, and much fewer moulds are required to do the same amount of work.

For other works, too numerous to detail, this machine will also be found to be invaluable, both in facilitating and quickening the process employed, and also in enabling them to be carried on at a reduced cost.

THE PONTIFEX NEW PATENT IMPROVED AMMONIA PUMP.

The only parts of the Pontifex machine which move and therefore wear are the ammonia pumps. With a view of making these even less liable to give trouble than heretofore, Pontifex & Wood, Limited, have invented a new and greatly improved arrangement of pump which has been found to give the greatest possible satisfaction.

The illustrations on the opposite page show the new patent ammonia pump. Instead of being made as heretofore of the plunger type, and single acting, the new pump is made of the piston type and double-acting. Consequently, one pump throws double the quantity, and in a continuous stream, and each machine can do its full work with one pump only going. In addition to this, the place of the old pattern plunger of large diameter is taken by the new pattern piston-rod of very small diameter (only $\frac{5}{4}$ inch in the smallest and $1\frac{1}{8}$ inches in the largest pumps for corresponding machines), and the piston-rod gland being so small is very easily packed and kept tight, and the loss of ammonia in the ordinary working is almost entirely prevented.

These new pumps are so designed as to fit in the places of the old pumps on existing machines, on which Pontifex & Wood, Limited, strongly advise their adoption. These pumps are now put to all new machines.

SPARE PARTS AND FITTINGS.

The only parts of the Pontifex machines which wear are the ammonia pumps, which as already explained are in duplicate.

NEWCASTLE-UPON-TYNE.

REPORT BY CONSUL PUGH.

There is not a single refrigerator in use in the city of Newcastle, or, so far as I have been able to learn, in this district, in the sense in which the term is used in the United States, and about which information is sought.

The hotels and clubs use a small ice-box, crude in construction and of inferior capacity, but aside from these the refrigerator is not in use in any form.

This being a cool climate, butchers, poultry, fish, and game dealers have relied wholly upon the natural temperature for the preservation of their stocks, aiding nature simply by throwing the entire fronts of their rooms open during the day, and at night closing by means of open iron grating, thus securing a free circulation of air to all parts of the rooms.

By this means their meats are kept in comparatively salable condition without the use of ice or refrigerator, except on occasional hot days in summer, when a small per cent. of the dealers procure a small quantity of ice and place it on the benches and tables among the meats. However, a number of butchers in response to my questions have informed me that during the many years they had followed the business they had never bought a pound of ice.

As to interrogatory No. 5, I find the ice used here is imported from ports on the east side of the North Sea, principally Norway, at a cost of about $4.20 per ton in cargo lots, but the retail rate to the consumer is about 48 cents per 100 pounds.

The butchers, poultry, fish, and game dealers, recognizing the inconvenience of the present system, as it necessitated their carrying small stocks and occasioned frequent losses, have pretty universally agreed to adopt the plan of and have taken stock in the Northern Counties, Ice Making and Cold Stores Company, a prospectus of which is inclosed.

The necessity of some such plan as this, and the difficulty of introducing the American refrigerator, can only be appreciated by a knowledge of the diminutive quarters occupied by these dealers, the average size of which would not exceed 18 to 20 feet square; and yet this small room must accommodate counters, benches, scales, cutting-blocks, cash desk, stock, etc., with some little space for salesmen and customers.

A glance at any one of these will at once disclose the absolute want of space for a refrigerator of any valuable capacity.

The cold stores and ice company above alluded to was formed and stock apportioned long before the dispatch reached me, but in discussing the subject of refrigerators the members and officers of this com-

pany admit the importance and advantages of their use, and I therefore made to them this suggestion:

That as dealers in the outskirts of this city, those in the numerous surrounding towns, and especially those persons engaged in the very large fish trade at the mouth of the Tyne, would not be able to utilize the cold stores and become patrons of the ice company, and as they desired to extend the sale of their ice, would it not therefore be a good investment for the company to purchase a number of refrigerators of such size as could be used by dealers not accessible to their stores, furnish them to such persons at a stipulated rental and provide them with ice, thus extending their ice trade and making a profit off both ice and refrigerator?

The company appear to think it a good plan, at least in extending their ice trade and educating these dealers to the use of ice, and have asked me for estimates covering size, capacity, for both ice and meats, construction and costs, with a view to acting upon my suggestion.

I therefore suggest and recommend that our manufacturers forward to me their circulars and price-lists covering these points, to be placed before this company, or any persons whom I may be able to interest in the matter.

HORACE C. PUGH,
Consul.

UNITED STATES CONSULATE,
Newcastle-upon-Tyne, November 25, 1889.

PLYMOUTH.

REPORT BY CONSUL FOX.

Refrigerators are not much used in this district except by confectioners, hotel proprietors and purveyors, only few private families using them.

The ordinary chest or box refrigerator is mostly used.

Refrigerators are made in many sizes commencing at 22 inches wide, 20 deep, 29 high, and continuing as large as 50 by 34 inches. Ice safes and refrigerators are also made as large as 75 inches high, 39 wide, 27 deep.

Most of the ice used in this district is obtained from Norway and is retailed at about $4.86 to $14.48 per ton of 2,240 pounds. There is also a local ice company whose prices are about the same as above stated.

To introduce American refrigerators I can only suggest the establishment of an agency here for their sale.

THOMAS W. FOX,
Consul.

UNITED STATES CONSULATE,
Plymouth, January 2, 1890.

SHEFFIELD.

REPORT BY CONSUL FOLSOM.

The use of refrigerators in this consular district is exceedingly limited, as there is but little ice used. Dealers in ice here are the fishmongers and a few dealers in poultry, and hotel keepers employ small ones of a cheap class. I do not think the butchers use either ice or refrigerators and they are certainly unknown in private houses. Even in the summer iced drinks are considered a luxury, and in most places here a novelty.

The only peculiar requirement would be the keeping of a small block of ice for the longest possible time.

The most of the refrigerators in use are manufactured in London and Birmingham; a few, however, are manufactured by the Haslam Foundry Company, at Derby.

The few in use are small in size, not larger than those ordinarily found in private houses in the United States, and the prices of the same are not readily obtainable here.

Little or no ice is secured, and none to my knowledge is manufactured artificially. It is procured from Norway and Canada, and is sold, at retail, at about $1 per hundredweight of 112 pounds.

No doubt the use of refrigerators would be beneficial to the consumers of food, but the price of ice renders their use a luxury, and it is doubtful whether any successful introduction of the article could be made here except among a limited and wealthy class.

There is comparatively little hot or sultry weather experienced here, even in mid-summer, and but few precautions are taken for the preservation of foods and liquids. The former are bought in small quantities and the latter are kept in cellars where they retain a moderate degree of coldness. The inhabitants are so conservative in their views, and so disinclined to make radical changes in anything, that I doubt if even so useful, and to us so necessary, an article as the refrigerator could be successfully introduced.

It is possible, however, that something might be done in the way of introducing refrigerators of American manufacture through large commission houses—such, for instance, as that of W. B. Fordham & Sons, limited, 36 to 40 York Road, King's Cross, London.

BENJAMIN FOLSOM,
Consul.

UNITED STATES CONSULATE,
Sheffield, January 15, 1890.

SOUTHAMPTON.

REPORT BY CONSUL BRADLEY.

Refrigerators are extensively used in this consular district.

There are no peculiar features in the construction necessary to the requirements of this climate. Those in general use are manufactured in London.

The principle of construction does not differ materially from those made for the temperate regions of the United States, but are more unwieldy, and not so light and convenient, and as a general thing do not present a neat appearance for family use. The cheapest refrigerator costs $15 and is used for cooling wines and waters only. The best and largest refrigerator for family use costs $125.

There are intermediate sizes and prices, and all are designed to preserve meats, fish, and butter free from taint of foreign flavor.

The chief supply of ice is brought from Norway, and the price per 100 pounds is usually 60 cents. Ice is manufactured at Portsmouth, but in small quantities.

We have frequent communications with reference to the most successful method of introducing wares, and we usually reply that "by commission" is the best manner.

Owing to the proximity of this district to London, it is supplied by agents there, and not direct from the manufacturers, thereby increasing the price to consumers.

Presuming that an article of commerce will sell more quickly by being cheapened, I would say that manufacturers should reach a desired market direct if possible.

Our opinion, therefore, is that advertising matter should be furnished to the principal consular offices with power to designate a per centum off that will bring the article to a basis of desirability.

No doubt an agency might be established in each consular district in this manner.

I would suggest that if a suitable place were secured for the exposition of the articles of manufacture most likely to sell, in each consular district, it would be the most successful method of introducing articles of American manufacture, but the plan is not feasible because of the restriction placed upon consuls by the consular regulations.

Otherwise consular officers could give the matter most profitable attention.

I am of the opinion that American refrigerators would come into general use by reason of their cheapness and lightness.

JASPER P. BRADLEY,
Consul.

UNITED STATES CONSULATE,
Southampton, February 11, 1890.

IRELAND.

CORK.

REPORT OF CONSUL PIATT

Refrigerators are chiefly used in the dwellings of the wealthier classes of the people in this district, also in hotels, clubs, infirmaries, hospitals, etc., but only to a very limited extent. They are for the most part made at Birmingham, Sheffield, and other hardware manufacturing towns in England. They vary in size, the smaller ones being about 24 by 40 inches, having principally metal frames with zinc siding and roof perforated. The roof is oval in shape, forming a cone, at top of which is placed a wooden ball as ornament. These small refrigerators are suspended from a hook or spike under a shed or in some unexposed part of the house-yard at rear of kitchen. The price is from $2 to $2.50. The next size, similarly constructed, cost from $3.50 to $4.50. Larger ones, provided with shelves running through them, cost from $5 to $7.50, and rest on raised blocks or platforms.

The ice used in this district, where none is produced, is exclusively imported from Norway. There are but two firms or merchants in Cork who import whole cargoes of ice—one being a large bacon-curing establishment, which import it for their own use; the other imports cargoes for retail demand. About ten cargoes, averaging 500 tons each, are imported annually. The invoice price to the merchant is about $10 per ton, and it is sold retail at about 80 cents per 100 pounds. The price varies according to the season, it being sometimes in summer about $22 and in winter $14.60 per ton. Ice is secured or preserved for larger or wholesale uses in cellars fitted up specially for the purpose, large enough to contain several hundred tons. In households it is generally kept in wooden tubs, small barrels, or buckets covered over with sacks or cloth. Ice boxes or chests are not in use.

In households where refrigerators are not in use a surplus of food or liquids seldom accumulates, and ice is rarely used, except for medical purposes, as in cases of fever, etc.

For household purposes generally there does not appear to be any great need for refrigerators in this district, the supply of food and liquids being procured invariably tri-weekly. Again, the heat in summer seldom goes higher than 65°.

It is possible that refrigerators on an improved plan manufactured in America and put in the market at a cheaper price would find a sale—not directly, however, but through the English hardware centers. The demand here would not be sufficient for a direct trade with American manufacturers.

JOHN J. PIATT,
Consul.

UNITED STATES CONSULATE,
Cork, July 7, 1890.

DUBLIN.

REPORT BY CONSUL REID, OF DUBLIN.

Refrigerators are used in this consular district but to a very limited extent, and only in public and semi-public places. There are no peculiar features observed in the construction of those used here, except as noted below. As a rule, they are manufactured in the United States. The sizes and formation are not peculiar, while the prices are about the same as in the United States, with something added to cover the cost of transportation.

Ice in use in this district is brought from Norway and stored in ice-houses, from which such demand as there is is supplied. Occasional consumers pay nearly two cents per pound therefor. The price charged to season customers is about three-quarters of a cent per pound.

In further explanation of the foregoing answers, I have to say that the use of refrigerators in Ireland, even by the wealthy classes, is almost unknown outside of Dublin, Belfast, and Cork, except in hotels, in a few instances; and even in the larger cities the demand for them is very limited. They are in use only in hotels, cafés, etc.; very few private houses are provided with them. The reason for this is, first, that the extremes of temperature are very seldom, if ever, reached here. The mean annual temperature of the country is from 48° to 50°. The extreme of summer temperature is usually from 80° to 85°, but only a few days of each season are as warm as these figures indicate. In the winter, mercury only occasionally touches the freezing point. Secondly, because of the climatic conditions above mentioned, there is no ice produced in the country and but very little used —none at all in private houses. In fact, the need or want of it is but little felt. The breweries use machinery to establish a low degree of temperature for storage purposes.

Many of the refrigerators in use, being for special places and purposes, are made to order, and are stationary. Such limited general demands as exist in this line are supplied by refrigerators of American manufacture. I am so informed by the representatives of two firms in Dublin controlling whatever of trade there is in this direction. The particular kinds most in use here are the Alaska, manufactured by the Alaska Refrigerator Company, and the Belding, manufactured by the Belding Refrigerator Company. I am informed that the competition for the trade offered by British manufacturers is scarcely worth mentioning. The American manufacturers produce a much better article at a less price than British competitors offer.

As the best way of extending the refrigerator trade in this part of Ireland, I would recommend to parties or firms thus interested to correspond with Thomas McKenzie & Son, 212 and 213 Great Brunswick street, and John C. Parks, 110 and 111 Coombe, Dublin.

ALEX J. REID,
Consul.

U. S. CONSULATE,
DUBLIN, *January* 7, 1890.

SCOTLAND.

DUNFERMLINE.

REPORT BY COMMERCIAL AGENT REID.

Refrigerators, as understood in the United States, are unknown in this consular district.

Ice, in very limited quantities, is purchased in Edinburgh for the use of makers of ice-cream, and a still more limited extent by butchers, for a very short season in summer, for the preservation of meats.

The amount of consumption being well known, the killing of animals is regulated accordingly, and the cellars are always cool enough to render ice almost unnecessary. Price of ice per 100 pounds, 37 cents. Summer heat rarely exceeds 74° to 78°.

JAMES D. REID,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Dunfermline, February 4, 1890.

GLASGOW.

REPORT BY CONSUL BROWN.

In answer to the first interrogatory as to the use of refrigerators in this consular district, will say that they are used but to a very limited extent as compared with their use in the United States.

There are no peculiar features required in the construction of refrigerators for use in this district, unless it be that refrigerators with less heat-resisting power would answer here, where it is called excessively warm when the thermometer registers 70° to 80°. I may add, the latter point is rarely reached.

Some of the refrigerators in use here are manufactured in London, but, as far as I can learn, the larger and better ones are of American manufacture. I should add that there are no small refrigerators or next to none in use here. I have visited a number of small or medium sized meat and fishmonger shops, and in no case found a refrigerator. They have a device of their own in most cases, and quite crude and unscientific. Refrigerators for family use are practically unknown.

The few that are in use, for the most part, are built within the rooms occupied by them. Of the smaller sizes, such as would be kept in stock, I have been unable to find any, though I have made inquiry of several alleged dealers. The trade is so small that quotations of prices are impossible.

Ice is secured in this district mainly from Norway, though some is secured from lakes near the city (thin and of consequent poor quality), and a small amount manufactured. Ice from the Baltic is worth, de-

livered here, $6.32 per ton, and is retailed at 48 cents per 100 pounds. I have talked with many persons, and all unite in saying that a more general use of refrigerators is most desirable, but in this connection it must be borne in mind that the climate here is far from what Americans would call hot, and refrigerators are not absolutely and indispensably necessary.

It is believed, however, that if the people came to understand the luxury, not to say the essential need, of refrigerators that a demand for them would spring up at once.

It is the unanimous judgment of those with whom I have conversed upon the subject that a refrigerator which would consume a minimum quantity of ice and which could be placed upon the market at a reasonable price would surely find sale. As to the best method of introduction, I am not so sure. Persons making the attempt should bear in mind what I have said of the climate, price, and quality, and remember that the Scotch are a conservative people, and that any new thing, however meritorious, would need "pushing."

A live representative, with refrigerators to confirm his statements in actual use, would, I believe, in time, be successful in building up a trade which would yield ample returns.

L. W. BROWN,
Consul.

UNITED STATES CONSULATE,
Glasgow, January 21, 1890.

LEITH.

REPORT BY CONSUL BRUCE.

Refrigerators are not extensively used in this cousular district. Only here and there a brewery, a butcher's establishment, a hotel, or a private house form exceptions to the general rule. The weather is too cool to make them necessary in domestic economy. Younger & Co., of Edinburgh, large ale brewers, have an extensive pipe cooler (see Inclosure A), the cooling of the ale being accomplished not by ice but by water of natural temperature running against the ale pipes in opposite direction.

The ice in the ordinary domestic refrigerator is placed in the bottom of the chest, and the box is fitted with sliding zinc shelves.

The refrigerators used here are manufactured for the most part in London, although joiners or carpenters in Edinburgh often make them, as they may be required.

The domestic refrigerator (see Inclosure B) in use here, and known in the trade as refrigerator or portable ice house, is a square box from 22 to 50 inches in height, length, and width, resembling a wooden cube, on feet that raise it a few inches from the floor. The price ranges from $15 to $50.

Ice is brought to Edinburgh and the west of Scotland from Norway, and is worth at the unlading of ship about 40 cents per 100 pounds, and ranges from 50 cents to 60 cents when retailed during the season from June to August. There is one ice manufactory in Edinburgh, but I have been advised that the business is not profitable to the proprietors. In a word, the climate here is so cool and equable, even in the three summer months, that there is not the need or demand for ice or refrigerators as in warmer climates. It is only now and then that one comes upon ice-water on draught, and it is not common upon the table as with our people in the United States.

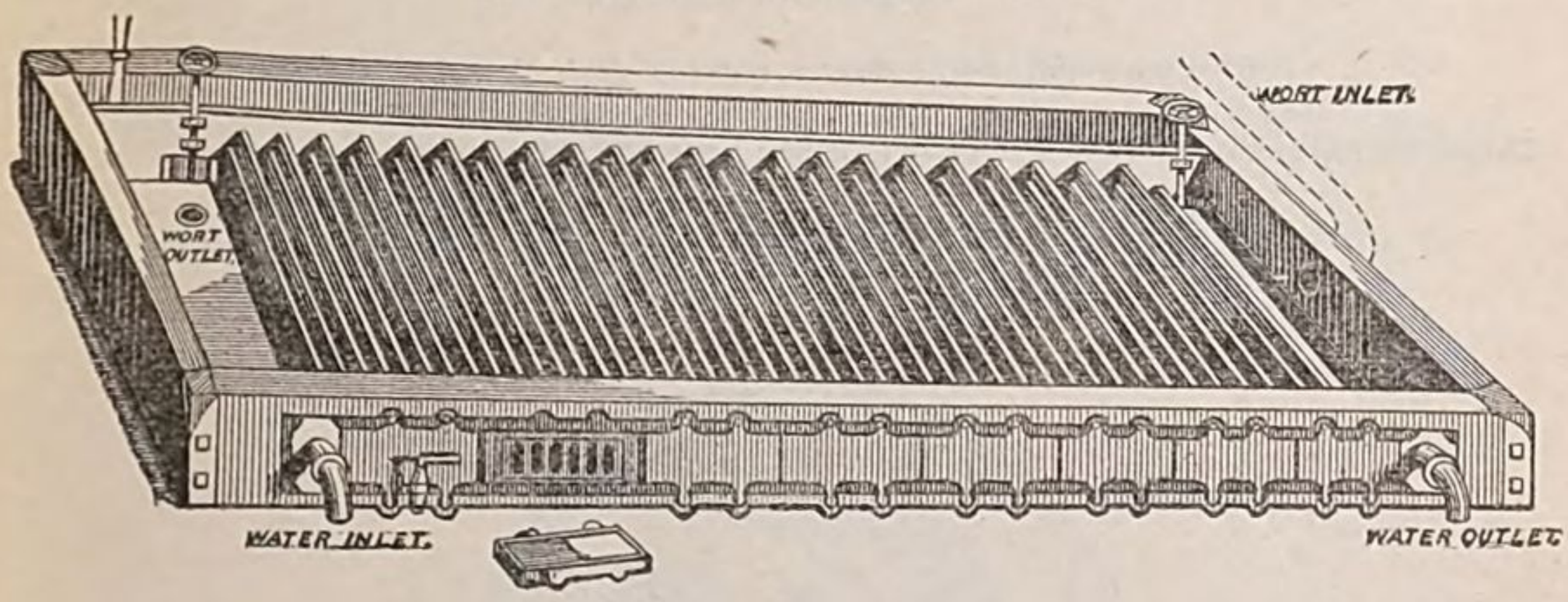
I also inclose herein a catalogue (illustrated) of "ice making and refrigerating machinery," recently published (marked Inclosure C), which will be of service in showing the kind of apparatus used in Great Britain.

WALLACE BRUCE,
Consul.

UNITED STATES CONSULATE,
Edinburgh, February 28, 1890.

***Wort** refrigerator, manufactured by Stewardson & Hodgson, 356 Leith Walk, Edinburgh.*

[Inclosure A in Consul Bruce's report.]



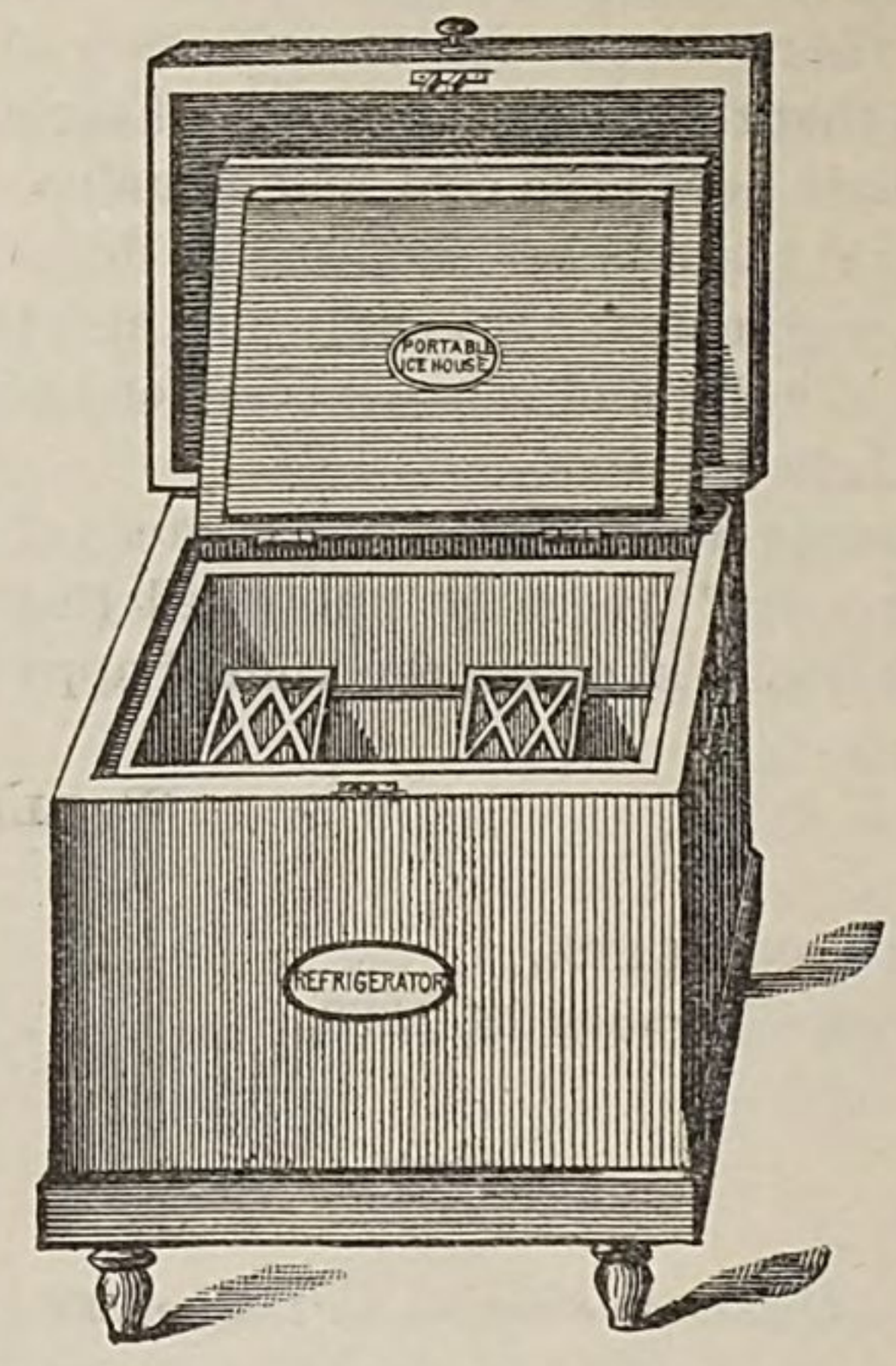
PRICES.

[Delivered f. o. b. or rail in Edinburgh.]

To cool 5 barrels per hour	£40	To cool 30 barrels per hour	£150
To cool 10 barrels per hour	70	To cool 35 barrels per hour	180
To cool 15 barrels per hour	90	To cool 40 barrels per hour	200
To cool 20 barrels per hour	110	To cool 50 barrels per hour	240
To cool 25 barrels per hour	130	To cool 60 barrels per hour	280

Refrigerator or portable ice house.

[Inclosure B in Cousul Bruce's report.]



SIZES AND PRICES.

[Fitted with sliding zinc shelves, painted, grained, and varnished.]

This is the refrigerator said to be mostly in use in Leith and Edinburgh.

SPECIAL CONSULAR REPORTS.

EUROPEAN EMIGRATION.

STUDIES IN EUROPE OF EMIGRATION MOVING OUT OF EUROPE, ESPECIALLY THAT FLOWING TO THE UNITED STATES.

MADE UNDER THE AUTHORITY OF THE DEPARTMENT OF STATE DURING THE YEAR ENDING OCTOBER 1, 1890,

BY F. L. DINGLEY.

ISSUED FROM THE BUREAU OF STATISTICS, DEPARTMENT OF STATE.

ALL REQUESTS FOR THESE REPORTS SHOULD BE ADDRESSED TO THE SECRETARY OF STATE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1890.

EUROPEAN EMIGRATION.

ITALIAN EMIGRATION.

Perhaps Italian emigration better than any other illustrates the fact that it is the geometric ratio rather than simple proportion which hunger and ambition invoke among the masses of the people in modern times when once the rivulet of emigration has been set in motion. A few years ago the Latin race in the United States was represented mainly by an occasional Italian, with his hand-organ and his monkey, or with his scissors-grinding wheel, a curiosity of population rather than a factor of the census. It is interesting to note how great results flow from causes in themselves apparently trivial. The organ-grinder, the harpist, the scissors-grinder, the proprietor of the monkey got on in the American world as he never got on in Italy. He sent word to his friends in Calabria, in the Basilicata, and in Salerno. His family was brought over; his cousins and his aunts followed. The movement at first was an obscure one. It takes time to create rivers; but the success of the forerunners really made the present stream of Italian emigration. I have asked scores of Italians in Naples, intending emigrants to the United States, "What leads you to emigrate?" The uniform substance of their reply is this: "My friend in America is doing well and he has sent for me."

The factors of organic evolution are two, appetite and affection. As Schiller says, "While philosophers are disputing about the government of the world, hunger and love are performing the task." The imposing movements of population in modern times obey the same law; they are as irrepressible as they are irreversible. The stream may be dammed or diverted, but can not be stopped. The wise legislator will not legislate against nature. He will seek to divert where he can not stay, to direct where he can not annihilate. The problem of Italian emigration is not to be solved by letting the emigrants drift, but by skillful manipulation of the factors of selection and education. The Latin race possesses intellectual and industrial qualities which will prove of value in fusion with American stock.

The logical genius of a people whose institutions and laws are the germs of modern government and law is potential even in its illiterates. Than the educated and disciplined Italian of Naples, Florence, Rome, or Geneva, few modern men or women are more conspicuous, whether we speak of mere size of hat, or of social or political development. Mod-

ern governments dawned in the independent cities of Italy in the Middle Ages.

The problem of emigration is not one of mechanism but one of character. Hence, of first importance is the character of the Italian who comes to our shores. To pursue this study best, we must repair to Naples; for Naples is the chief distributing point of the Italian races. From Naples, twenty great fleets of ocean steamers sail monthly to the East, while scores of steamships sail thence to other parts of the world. Naples is the cosmopolite of the southern races, Oriental and European —the great halting place between Europe and Asia where, as in the days of the Pentecost at Jerusalem, all races meet in an industrial symposium as they used to meet on the other side of the Mediterranean in religious symposia. The fez and the palm, the top-hat and the no-hat, Asia, Africa, and Italia, Armenians, Jews from Asia Minor, turbaned swarthy Indians, and kinky-haired Africans, climb into the steerage today hard by where Saint Paul entered on his wanderings twenty centuries ago. Let us then enter the lodging houses of Naples and climb into the steerage of the ships in the harbor of Naples and see what manner of persons are about exploiting the land which European emigrants first discovered and then possessed.

First, a visit to places where intending emigrants are thronging. Obviously, in this group of several hundred there is hardly one who ever has been a dweller in cities. They are families, more than individual adventurers, rustics, clad in homespun, faces brown, hands horny, vigorous in body, but if illiterate not stupid, if poor not paupers. These people are chiefly the peasant farmers of Calabria. I find in the group half a dozen who have been in the United States but who have returned for their families. One has sold his little home to raise funds for the journey; another has received a prepaid passage. Several do not know where the United States is located, but they think it is somewhere near New York. Later on we shall have more typical cases. Yet all these men apparently are intellectually above the average so far as native powers are concerned. You say, "They are not good citizens," but you add, "Are they not raw material for good citizens." The obvious reply is, too much raw material is politically indigestible. The point practical is to take as much as we can profitably assimilate. The prophet who can tell us where and when to draw the line, is the prophet the American Government apparently is waiting for. To shed light in this further question, if possible, let us look at the Calabrian peasantry a little more closely.

Here is the steamship *Britannia*, destined to sail to-morrow from Naples (the spring of 1890); she is lying near the quay in the harbor, surrounded by a fleet of small boats, loaded with emigrants, who have their household effects in bundles in their arms. It is an exodus not of political or of religious persecution; obviously the gospel of this movement seen in these half-fed faces is the gospel of want. Hunger, which

orientalized Europe, seeks now to fertilize the newest civilization with the oldest. There was never in politics so much bread and so little butter.

There are now 1,048 steerage emigrants on board the *Britannia*. A careful study of these will give us a clew to some of the hidden things of the Latin movement. At the entrance of the steerage on the upper deck of the ship sit Italian officials—the chief of police, the doctor, the captain of the ship. One by one the emigrants appear with their passports, are examined, questioned, their papers inspected, the sheep and goats separated. There is one goat among the 1,048 sheep and lambs. He is excluded for lying about his age. An obvious inconsistency exists between his papers and himself. His pockets are turned inside out; he is a farmer; has about 20 francs in money, a prayer-book, two old letters, and a ticket to New York; but he can not go. Two weeks later I shall see this same person crossing the frontier and going to New York via Havre. I said that it is hard to stop a stream but easy to divert one. This Neapolitan farmer is an illustration of how you may fail most when you fancy you are succeeding best in stifling freedom of individual movement.

The Italian Government does not want these Italian farmers to emigrate, and they have hedged them about with many restrictions which do not restrict. All able-bodied young men must first have served in the Italian army before emigration is possible—save by jumping the invisible fence that separates Italy from France. Hence one is not surprised to see that more Italians than Frenchmen emigrate from France. It is the law of the unexpected which emigration illuminates.

As the emigrants here on the deck of the *Britannia* file up one by one before the Italian Government officials, one gets the autobiography of each, and, by and by, interesting facts will trickle out in spite of shrewdest intentions to be reticent. There are triple guaranties for the protection of the emigrant, and one of these is in the hands of the police; the emigrant carries a second in his pocket; the emigrant agent carries another in his archives. These guaranties are a contract that the emigrant shall be honestly delivered to the port of New York; hitherto many Italians who thought they were bound for New York have woke up in the Argentine Republic. Thousands of emigrants have thus endured vast hardships in unexpected and undesired lands.

Very few of these Italian peasants can read or write; they can not even sign their names. I said the Italians emigrate also from France, and this ship calls at Marseilles, but she will take thence only two Frenchmen. The French do not emigrate. It is the Italians who now supply raw muscle for the Yankees. All the emigrants of the *Britannia's* list prove to have been vaccinated and in health. The chief of police sees in them no deserters from the army, no criminals that his gallery records. The emigration agent looks on with anxiety, because his commissions are

reduced by rejections, and violation of the law subjects him to heavy penalties. The police search the ship for stowaways.

The ship's steward displays the following bill of fare for the steerage passengers: Bread, biscuit, rice, macaroni, pea-soup, salt fish, potatoes, cheese, coffee, sugar, pickles, salt, and wine in fixed and supposedly proper qualities and quantities. If this bill of fare is materialized these 1,048 Italians should look less lank in New York twenty days later than they now do. On some lines the stewards wax rich by impositions, like charging 25 cents for a cup of coffee.

The women on their heads wear bright kerchiefs, brass jewelry in their ears, and they crouch on the deck upon their household effects which as a rule consist of one bundle. A group of unwashed children, quite young, almost invariably testify to the fact that the incipient stage of Italian emigration was long ago passed. The family is not the courier of emigration. When the children go we may regard that for better or worse; the emigrant is no longer an adventurer or a bird of passage, but for better or worse a coming citizen. These adults will pick up a little pigeon English in the United States; they will form a new *patois;* but these children, with the rare knack of universal infancy, will soon be speaking two languages with the facility of the ancient Romans, who had pentecostal gifts before they ever heard of pentecostal miracles.

We can not expect that any but the contingent of these emigrants that are on the juvenile list shall assimilate with Americans. Assimilation must be preceded by the gift of tongues, and men and women rarely learn to wag their tongues in new position after they are twenty-five years of age. Hence Italians of the first generation are less desirable as elements of our population than Anglo-Saxons of the first generation. We must wait awhile before dogmatically predicting the status of the Latin family in America after adoption has ended in assimilation.

This Italian mother is under thirty years of age; four children are frolicking in and about her lap beside one infant imbibing refreshment in instinctive Eden simplicity. The mother will meet her husband in New York. What is he doing in New York? Selling vegetables. He came over last winter to spend the cold months when vegetables on the street were impracticable. He returned in the spring; his family now follow him. I suppose that on this ship there are a dozen similarly conditioned families.

Another typical case: Here is one mother with two boys of ten and twelve years respectively. They have enough money to pay their passage less five lire; the benevolence of the ship prevails. They are allowed to pass on to Canaan. They will land in New York without a sou—not paupers in the sense of ever having been a public charge, but pitiably poor, with an American scissors-grinder, head of the family, between them and the poor-house. This poor woman cried bitterly for sorrow when she found she had not quite money enough to get to America. She cried for joy when the ship agent says, "Take 'em." I

am assured that many emigrants fall just a little short of the necessary passage-money as a diplomatic dodge, but such is the discriminating mind of shippers they generally are able to detect the counterfeit, and to separate the wheat from the chaff. But certain it is that hundreds of these Italians land in New York without a franc in their pockets. The more's their credit if they pick up a livelihood.

Here comes another type: His is a figure familiar to the emigrant agent and to the Neapolitan steam ship lines. For twelve years he has annually been seen returning from New York as the swallows homeward fly. He works "in the States" from April to December, returns to his Calabrian hut and his domestic gods each Christmas, stays till the Yankees begin to talk of more railroads, books again for the States; and so on in cycles of American toil and Italian moil. He says that it is cheaper for him to spend his money where he doesn't earn it. He may finally turn out to be a good American citizen, but not, I submit, until he has cost us more than he is probably worth.

Another citizen of no mean Italian city files before the inspector; he also has been in the United States before; he is returning to his "lodgings" in our country, which is not his continuing home; for he is also a pilgrim whose pilgrimage knows no end. What is his business? He is a harpist and has been playing his romances to Philadelphia for the past ten years, taking intermissions at summer resorts and on suburban steam-boats. He is now returning with his three children and contemplates permanent residence in our country, where he says he can make money and a living, which under present conditions of life in Italy he can not do in his native land.

Yet another is a skilled worker, a mason; has been ten years in New York; has returned to Italy for his family; gets $4.25 a day for his work in New York City. "What can you get here in Italy?" "About 60 cents a day," is his reply. He has five children destined to become American citizens.

Here is one Italian woman weeping copiously. She can not buy her passage and she is sent back to the quay. Probably a mysterious purse will yet spring out of her pitiful petticoats. Her grief, I am told, has a suspicious background, being too hysterical. Another says: "I have been in the United States and have come back for my brother's children; he is busy and he paid my fare. I am a preparer of glove leather; I get $12 a week in the United States; here in Italy I could get but 15 francs ($2.90) a week." He is an intelligent man and has picked up enough English to get on with.

All these emigrants are courteous and orderly. The adults are from thirty-five to forty years of age on an average. There are few men between twenty and thirty, for such are subjects of military duty; but 20 per cent. of the 1,000 on board the ship are below twenty years of age.

There is another type. He is a carpenter; has been over to America

twice; is now returning to Italy, where he has been for a year; gets $2.50 per day in New York; will stay in the United States a few years longer and then return to Italy and buy land.

Another is a barber; has a shop in New York city; has come back to Italy and married; is moving with his bride to the United States, where he intends permanent domicile.

A carpenter forty-two years of age has been in Cincinnati, Ohio, and is returning with his family to remain in the United States, where he can get on in the world.

Another is a shoveler, an old man, making his second trip—an Atlantic circuit-rider.

The next in sight is also a bird of passage, has been four years in the United States, "milking cows in Pennsylvania."

A suspect is examined and his assets are as follows: One biscuit, 1 bottle of wine, 60 cents, 2 pieces of soap, and a clean pocket-handkerchief. "He's afraid they'll rob him," remarked the Italians in the group. "I'm a poor man, I've had little food, I look older than I am, I'm a farmer;" so much he says with a pathetic tremor which carries sympathetic conviction mixed with intellectual doubt. He swears he is but twenty-three years of age. Trouble sometimes makes twenty-three look like forty. But not even his soap saved him. He is rejected. As he was helped ashore an Italian remarked: "He's afraid they're going to hang him."

It is not necessary to multiply examples. One is astonished to find so numerous a contingent of quasi-emigrants, of men shifting countries annually, many of whom, no doubt, eventually become permanently in touch with our soil.

I was able to find among these 1,075 emigrants not one dweller in an Italian city; all were peasants originally in Italy, but many of them had grown into trades in the United States. The ground that separates skilled from unskilled labor is not a gulf; machinery has simplified the passage. A machine is a short cut to semi-skilled labor for a mind of ordinary intelligence. Hence the tendency is for greater relative scarcity of unskilled labor. It is already easier to get a man to run a locomotive than to find a man who will hold a plow. It is not certain that Cincinnatus ever went back. The Irishman who said "America is a great place," was unique when he added: "All I have to do is to carry the bricks to the top of a five-story building, and a poor fellow is there who does all the work'."

Even most of his race now prefer the trowel to the hod, and as the Irish took the unskilled work off our hands a quarter of a century ago and the French Canadian came to relieve the Irish, it is now the Italians who have come to relieve the Canadian French. It is impossible to develop new countries, to open up new railways, to build new cities by skilled labor. New countries require a larger contingent of raw muscle than old countries. The Italian came because he was wanted;

he was wanted because he was needed; an irreversible law will serve notice on him to stay away, by and by—that is when hunger, which drives him from his own peninsula, menaces him in the New World. That time does not yet seem to have come. The law of demand and supply may be intercepted, but it can not be repealed any more than the law of gravitation.

Now let the agent of the Florio Rubatino Steamship line speak:

We send many ship loads of emigrants [says he] from Palermo, in Sicily, to the United States during the spring—about 500 a month. We sent one load to Boston last spring. To Boston also we sent two ship loads from Naples. We have had four sailings per month for the past year. Last season we sent about 2,000 per month to South America, but now we are forwarding only from 200 to 300 per month to the South American States. If there is a large family, we give free passage to the children. They take their clothing and all their little assets in a bag. One-third of our Italian emigrants come back to us, and return again to the New World. None who are sick or feeble are allowed to depart. The doctors forbid and passports are denied.

The Italian Government had trouble with the United States because we sent over objectionable persons, and both the Government of Italy and the steamship lines are now more cautious. I never have seen a case of leprosy. The Italian officers ask each emigrant what he is going to do abroad and what means he has to return if he has not work.

Many of the emigrants do not know South America or North America as separate countries; it is all America to them. We have many Swiss emigrants passing via Genoa to New York. We shipped 4,000 to 5,000 to New York and Boston in 1889. I think our emigrants will average to have 20 to 50 francs each after paying their passage.

Another ship bound from Naples to New York furnishes more types: Three tailors, city bound, three women, who have been in the United States before; one digger, one coal heaver, who crosses "the ocean ferry" often; one stonecutter, who has also been in United States, where he gets three times the present Italian wage of his class.

What amazes is the size of the countercurrent. Sometimes as many as 1,000 Italians came back from the United States to Naples in the month of December. In hard cold winters and in hard times this countercurrent is stronger than in mild seasons and in good business cycles. About one-tenth of all the Italian emigrants are men who have been in the States before. One may easily distinguish them from the raw recruits; they are more independent, cleaner, better clad, and better fed.

During the past season (since March, 1890) the current of emigration to the United States has been a sort of Niagara, because the South American craze has ruinously collapsed. The financial and political cyclones in those unhappy southern countries have stranded many of the Italians who went to South America in 1888 and in 1889. It does not take long to stop emigrants from dumping themselves from the frying pan into the fire. Hunger is bad, but starvation is worse. The thousands who took assisted passages have had experiences which horror

only can depict. Their story is a household word in Italy. The United States is El Dorado as never before.

It is seen that paradise with bad government is hell. But the agents of the steamship lines, who cover Italy as the locusts covered Egypt, are busy as ever. They paint the charms of big wages in the United States; they often induce the poor peasant to sell his cow and move on the United States. There is a good deal of emigration that is assisted by rhetoric as well as by logic. The flowers of rhetoric easily woo hunger. Hopeless poverty eagerly confides itself to the possibility of an improved economic condition. There are castles in Spain even for the Calabrian. In this business the commission money of clouds of emigrant agents is the chief inspiration. The ship would starve without steerage list; there is large profit in handling large numbers, and some thousands of drummers for emigrants swarm over Italy, and their fruit is in the 5,000 Italians who in one week of the recent spring cut loose from the life of the Italian peasantry to try chances in the United States Many more applied in the spring of 1890 than the ships could carry, though they were crammed like sardines in all the decks and in tiers three deep, as my eyes have witnessed—ships which I presume emptied their swarming cargoes on our shores, but which should never have been allowed to leave any port of a civilized state, or, once having left, to touch the civilization of any other State.

With proper consular oversight in Europe many of the evils of emigration might be remedied or checked. The best place to cure the evils of emigration is the place where these evils are generated. On this point more will be forthcoming later on.

There is a factor in Italian emigration which is larger and more important than perhaps any other European factor of its class. I allude to the devotion of nationality. The Irishman loves Ireland, the Englishmen loves England and the German loves Germany, but more intense than any of these loyalties is the devotion of the Italian to his ancient and now united State. This sentiment is as profound among the peasantry as among any class, and nothing but the most pressing poverty would drive the Italian people in such numbers from their native land. Hence, when they have made a few dollars in the United States beyond the present wants, they hasten to their old homes. They love to spend their savings in Italy; it seems to them almost a sacrilege to spend them elsewhere.

As a Chinaman's bones can never rest or his spirit be free until his mortal remains are celestially interred, so an Italian peasant's dollars seem to bring him real peace only when they are spent in the place where he was born. The returning legions amaze the home people of Italy with their financial resources; for men who never had a dollar look on $75 as a rich reserve, and $100 is wealth. These returned emigrants flourish about their native Italian towns and set their neighborhoods aflame with desire to see the land where even the shovel and the

pick are transformed into gold. In this way Italian emigration is increased to no small extent, while prepaid passages yet further swell the stream.

How easily these emigrants fall into American manners one must have noted who has observed the effect of one or two years of American life on the abject and underfed Italian peasant. Between this adaptability on the one hand, and that intense nationality on the other hand, it can easily be seen that Italians who lose their grip of Italy will speedily get a powerful American bias. Their children at least are likely to be good citizens of the Republic, perhaps in many cases as valuable as the descendants of Gallic or Teuton stock, etc. Variety of stock must itself strengthen the race whose energies already express the best results of the combination of Northern races. As the Latin stock contributed not a little to German vigor, may not the same stock re-enforce the new nation on this side of the sea?

There unquestionably is conformity with the letter of the law of the United States prohibiting contract labor, but I judge by the enormous rush of pilgrims, who stay for brief periods, that in one way or another it is easy to conform to the letter and deplete the spirit. Yet on the whole, the law has done good, for it has enlightened the emigrant and forced the recruiting agents to exercise caution and to the choice of other bait.

The Italian beggars do not emigrate. The lazzaroni of Naples can not be induced to go elsewhere, for nowhere is life so easy, nowhere else can the hereditary loafer soak himself in merry sunshine all the day and be fed by ravens or other invisible agencies; for these idlers are uniformly fat without ever having done a stroke of work in the memory of man. As a rule the conditions of life in cities are such that dwellers therein do not migrate. Hunger moves the country, but the town seems to fascinate it. The movements of European populations in general are not at all from cities. If we get the illiterate emigrant we get also the bone and sinew of Europe. What manner of men and of women ensue depends in part on the environments which this country supplies.

The agent of the Anchor Line of steam-ships at Naples speaks thus:

> Our agency here in Naples received $5,000 last winter from Italians in the United States for their families in Italy. Each autumn the remittances commence, and every mail swarms with them from November to March. I suppose 25 per cent. of this money is used by returning Italians or by "prepaids." The number of Italians who came back from the United States last winter was unusually large, but with few exceptions they returned last spring to America. There has been a very heavy emigration to the United States this year (1890), and there is likely to be another movement to the States this autumn. In autumn families begin to appear in large numbers to join their heads in America.
>
> My impression is that Italians do not stop in New York now so generally, but they are scattering through the States, many of them in the country districts. All the emigrants are vaccinated before leaving Naples. We maintain a separate deck hospital but have small use for it. No lepers could pass our doctors; we never see a

leper. In 1888 we had cholera in the provinces of Italy but none in Naples, and we have had no cases since. Naples is in much better sanitary condition than a few years ago, because we now have as good a water system as any city in the world, an unlimited supply of the best of water, in place of the foul wells from which all our water was drawn until within a few years. The improvement in the health of the people was marked on the completion of our waterworks. Naples formerly was a notorious point for the distribution of disease, but I think its reputation in this respect is rapidly changing.

Italian emigrants move on South America from August until January. As many as twelve or fourteen steamers per month last year sailed from Genoa for South American ports, loaded with Italian emigrants, but the political disturbances have diminished the movement this year.

You get many Italian sailors in the United States, from Sorrento and other Italian ports.

The emigrating Italians are hard working classes, prudent, industrious, temperate, but ignorant and superstitious.

Many of them have this one object in life—to save money and buy a little land and cottage in Italy. Land in Italy is mainly owned in large blocks and landlords let land "at the halves." This makes the lot of the tenant a very hard one.

We ship quantities of macaroni from Naples to New York—about 20,000 boxes per month, and also many of the cheap wines of South Italy, with cheese—food and drink which the Italians in the United States consume. They naturally incline to live in the United States as they do at home, hence, so far as possible, they import what they eat in preference to consuming American products.

The standard of living of Italians is not as low as that of the Chinese but it is evident that it is far below that of our American workers. The second generation born on American soil tend more to a better diet.

The representative of the Anchor Line further remarks:

Of course we see in the ranks of our emigrants cases of apparent extreme poverty. Many have but a manila-sack full of assets, but they come back with water-proofs, trunks and shovels. They give us little trouble on board ship. Those who have been several times to the United States return and put on airs; they want to eat what formerly were luxuries, meats, especially, which they almost never saw in Italy on their tables. This is the effect of American life. They land in the United States with but a few lire in their pockets. They give you their work; they return with your money which they have made theirs.

No; people from town do not emigrate. The poor people can not be detached from cities. There are two causes, love of their city and the fact of absolute poverty. The Italian peasant is quite another person than the lazzaroni. The Italian workers are parsimonious; the lazzaroni never works. You in the United States get our better industrious lower class. We could not get our tramps to go if we wanted to. You will find an improvement in the Italian emigrant of the future, I think, because education in Italy is now compulsory as it is in most of European states to-day. All he younger ones can now read and write.

This year gold has been 300 per cent. premium in South America—hence thrice more have gone to the United States than otherwise would have happened.

There are in Naples swarms of emigrant agents whose business it is to paint the glory of the New World to the peasantry of the Old World, for a percentage. There are numbers of these agents who buy one hundred steerage tickets outright on private terms and then "peddle them out as they can light their chap." There is a regular commission of 6

per cent. on steerage passages; but I am told that smart agents manage to secure other perquisites.

One emigrant agent thus speaks:

All sorts of inducements are held out to win emigrants. The interior of Italy is well-covered with posters and other reading, and from the United States come influences which lead emigrants into the Southwest and West where heavy owners of land desire to build up new territory. Many Italians are now emigrating to Africa, now that South America is in distress.

It is hard to get your first emigrant to an entirely new country; but once get them started and they go like a flock of sheep. A few years ago the first man was shipped to Brazil, and soon large numbers followed; but by and by the emigrant agents secured cheaper rates to New York and they shipped a load ostensibly to Brazil, but the emigrants were amazed on getting into port to find they were in New York. Thus Italian emigration to the United States began in a swindle; but once started the stream grew into a river.

In the streets of Naples one sees a reproduction of the ancient Roman scribe—the public letter-writer. These scribes are especially busy with American correspondence—Italians writing by dictation to their friends in the United States.

About 10 per cent. of the emigration to the United States from the port of Naples is Sicilian. Small steamers bring over load after load from Palermo, twenty-four hours distant. The Sicilian emigrants are somewhat less desirable than the Italian. The Sicilians are more inclined to be quarrelsome, and steam-ship companies do not like them so well as Italians. They are a wilder lot. The Sicilians naturally choose a warm climate. Most of them go to New Orleans; they are mainly rustics and many of them are good farmers; for the South they will be valuable.

In 1888–'89 the Italian Government undertook to check the outward movement of its citizens, but the restriction laws were of little avail. The Italians, who are masters of finesse, found easy means of circumventing the laws. Add to that the natural tendency of men to eat forbidden fruit, and one may easily see how the love of liberty and the bias for the fruit of the tree of knowledge rather fattened on the stones which were legislatively substituted for bread. The Italian Government saw its mistake; by general consent the screws were loosened, and now emigration from Italy is practically free—after military service is performed.

The American consul at Naples speaks somewhat as follows:

The Italian authorities in Naples undertook to forbid emigration last year, but this year they are less rigid. One steamer left here recently with 1,250 in the steerage—90 per cent. of them farm laborers, which means common laborers with a certain knowledge of farming. They are not quarrelsome but extremely quiet, temperate, and frugal. There is but one passion which, as a rule, turns an Italian into a fiend. Aroused by jealousy he is on fire. Transportation does not change the Italian nature.

Many Italians apply at the consulate for assisted passages to the United States. This consulate includes the south of Italy.

The water supply of Naples comes from the Appenines, 35 miles distant, and that is

almost a guaranty against special danger to the United States from contagion at this point.

There are two banks in New York which have branches in Naples that advance money to emigrants and contract for labor, as I believe, though I think everything is done verbally and nothing on paper.

Formerly our Government had a medical examiner here in Naples, who, to my certain knowledge, in more than one case prevented the export of cholera to the United States. Now we have no medical examinations here that are under the control of the United States; we must rely only on the surgeon of the steamer, and since many steamers are arriving here each week from cholera-infected districts it is evident there is great danger of the plague here, and hence New York is imperiled. Next year unusual precautions should be employed, as the prospect is that cholera, now sporadic in Europe, may become diffused.

I have several times discovered the existence of epidemics here in Naples through the doctor who formerly served the United States Government here. But for him, acting entirely in his private capacity, I should have been in utter ignorance of the dangers. For example, when cholera last appeared in Naples we had a sporadic case or two that were hushed up. I got private information that the cases actually existed. I waited a day or two for absolute certainty, and then cabled our Government the fact.

* * * * * * *

Thus through the kindness of the doctor, who formerly had been in the service of our Government, I was enabled to protect our shores from the impending peril; for when the shipping agent came to me for a bill of health for his ship I replied: "My dispatch has gone to the Department of State at Washington; that Department now knows there is cholera in Naples; I can not give you a bill of health." The shipping agents stormed and protested. I could only reply: "I am managing this matter; I shall give you a foul bill. If you sail, you sail at your own risk."

From this statement it would seem to be an easy and safe inference that, especially in seasons of contagion at points of European embarkation for the United States, our Government should protect itself, not in New York or Boston, but in Naples, Genoa, in Hamburg, Antwerp, and Liverpool. It is much easier to prevent than to cure.

And while speaking of the prevention of epidemics, it should be added that one great peril is from infected clothing and from rags. It would seem that, especially when epidemics are prevailing in Europe, all clothing should be disinfected and all rags disinfected or prohibited, and these precautions ought to be enforced before the departure of ships from foreign ports to the United States, as a condition of the issuance of a bill of health. The outbreak of cholera in Spain the present year, it is stated, was due to the failure to disinfect—germs of a former epidemic having been buried but not obliterated.

In the Berlin House of Refuge for the Homeless all clothing is disinfected, newcomers being stripped and washed while the disinfection proceeds. If such precautions are found necessary in periods when pestilence does not obtrude itself, much more needful must it be in periods when cholera is within a few hours of points whence thousands of people are embarking each month for the New World.

Sicily is a danger point of cholera. In Catania on the east coast of Sicily cholera raged severely a few years ago.

Another authority says:

Italian emigrants to Mexico and Costa Rica have been similarly cheated by promises of private companies. The revelations of the testimony made to the Congressional committee in the United States, regarding the impositions on Italian emigrants led to the enactment of a law by the Italian Parliament, under which emigrant agents must be licensed and deposit $1,000 caution money. This law forbids any assistance to men liable to military service, to escaped convicts, or fugitives from justice or of minors, organ grinders, and peddlers. Fees to the emigrant agent from the emigrant are forbidden. There are guaranties for the protection of the emigrant on board ship, and no emigrant is allowed to contract to pay the price of his passage in personal service. Any emigrant can claim double the passage money if he can show that his passage is paid in part or wholly by any government or by an emigration society or colonization agent. Imprisonment and fine menace violators of the law. Shipowners, who violate the law, are subjected to heavy penalties.

About 85 per cent. of the emigration from Italy to the United States comes from southern Italy, including Sicily. The proportion of women and children annually increases, showing an increasing tendency to permanent residence in our country.

A representative of one of the steamship lines in Naples makes the following statement:

Our municipal authorities here require certificates against our landing emigrants in the United States helpless. Their return to Italy as paupers is forbidden, and a bond is exacted from the friends of the emigrant insuring that the pilgrim shall not be returned to Italy as a pauper. This arrangement would seem to tend to keep the poorest in Italy as the surety must sacrifice if the returning emigrant becomes a charge on Italian poor rates. What effect this regulation has to prevent the pauper Italian from returning to his native land is another question worthy passing attention.

"Look at yonder public works here in Naples," remarks a Neapolitan shipper, "and you will see how working men in Italian cities fare. This is their noon hour." They are lunching on a hunk of bread, a little garlic and water—no wine—perhaps an orange. This is their dinner. The people here now drink water.

The law of 1888 regulating emigration agents has reduced the number of emigration agents in Naples from 60 to 24, many of the former emissaries being unable to obtain the required $1,000 bonds. Of the branch houses of banks formerly engaged in handling contract and other objectionable labor, only one has furnished the required security. Agents now get 6 per cent. of the passage-money, which is from 70 to 130 lire for adults. There are two New York firms or banks with representatives or branches in Naples, which furnish transportation to emigrants who have no money, shipping them to New York, where places of refuge or employment is provided. There is no positive contract, but this business is none the less in violation of the spirit of the law of the United States. I estimate that about 10 per cent. of the emigrants from Naples are supplied with advance tickets by these two banks controlled by an Italian capitalist in New York.

From 85 to 90 per cent. of the Italian emigration is the peasantry from the land; the rest are tailors, shoemakers, and carpenters, but not as a rule first-class workmen.

Mr. Landis, of New Jersey, has 8,000 acres in vines and other crops operated by Italian peasants in the United States. He has been in Italy and Sicily the past year studying Italian methods of agriculture.

About 15 per cent. of the Italian emigrants to the United States return to Italy to spend the winter and see their families and also as a matter of economy, as the fare

for the round trip is put very low and they would have no employment, or only intermittent employment, in the dull season. Some of those who return to Italy in the fall are provided with tickets by the New York firm of Italians already spoken of.

I think about 10 per cent. of the emigration is paid for in the United States by prepaid tickets. This 10 per cent. is not made up of shiftless idlers, but of those who "can't make a ra ise," as we say. It is the interest of shipping agents and of contract ors not to send men who can't or won't work. The lazy and the stupid are barred out by the self-interest of those who want to promote emigration for selfish ends.

I have repeatedly noticed that the older emigrants are the ones most liable to become a public charge. They are not so contented; they learn no English; they are more ignorant; they are too old to change, while the younger ones who return to Naples are bright as your dollars made over, speaking your language and with your newspapers in their pockets. Italians are very quick to learn when young and they can see as far into a pocket-book as any people in the world. If they are easily led they are also easily misled.

The Italian authorities forbid children going to the United States without their parents, unless proof is forthcoming that their parents are already there. Persons of no occupation are prohibited from emigrating, but farm hands are construed to have a trade. The Italian government is anxious to avoid complications with the United States, and the Italian authorities appear anxious to avoid any international discourtesy. The United States Government is respected here in Europe far more than in 1861, Tramps, beggars, and such classes are prevented from emigrating by contract, by the interest of the Italian as well as by the prohibitions of the United States Government, by the self-interest of shippers and agents, and by their own poverty. The risk of having a loafer returned is not carelessly entered upon by the steamship lines.

I have had repeated proof of the fact that the moral influence of the return of a few, even a handful, of beggars, organ-grinders and contract laborers by the ships that carry them to the United States, is efficient.

Speaking of the matter of contagious disease in Naples, a Neapolitan remarks:

We are very cautious in this matter, and an illustration will show that we have good cause for caution. The ship *Alesia*, of the Fabre Line, was quarantined in New York and nine persons died of cholera. The American consul at Naples had refused her a bill of health. The ship's agents complained he was fussy, but she ended in cholera, in a long quarantine, said to have cost the ship 80,000 lire. Evidently it is less profitable to export cholera than Italians.

Yet another, an American resident in Naples, says:

My opinion is that the time will come when you will have all the Italians whom you can use without self-mutilation. If you put a few drops of impure water into a glass of pure water you may not observe any serious deterioration, but a good deal of the impure water will spoil the whole. So long as this Italian movement tends to develop American internal improvement without degenerating American labor and standards of living, all will be well; but let us beware we do not suffer the nuisance point to be reached.

The military laws of Italy work against us, tending to give us children who are a tax on our resources and men over thirty years of age, who have passed the most productive part of their physical life. The third son is not liable to military duty; but if young Italians are United States citizens and come back to Italy, they are liable to be snatched up and transferred to the army. After three years' service a young man goes into the Italian reserve, but even then he can not go abroad without a permit. Of course none, as a rule, being allowed to emigrate past sixty years, we get fewer of the very old, but we do not on that account secure the most desirable.

The total emigration from Naples to the United States in 1889 was 15,709. In the first three months of 1890 the total emigration was ten times larger than for the corresponding period of 1889. From Naples, during the first three months of 1890, there emigrated to the United States 12,636 Italians and Sicilians. The movement from Sicily has been rapidly increasing during the past few years. From Palermo in 1887 2,201 Sicilians embarked destined for the United States; in 1888 the number advanced to 3,713, while in 1889 it moved up to 6,017; while during the present year the number is likely to be as great or larger.

The American consul at Palermo, speaking of Sicilian emigrants, says:

> The Sicilian emigrants to the United States are generally rustic and of the lowest type of the Italian as to character and intelligence, few, if any, being able to read or write. They have not, as a rule, a cent of money after paying their fare. There is no contagion at this date in Sicily and leprosy is now unknown. Steamship companies pay a certain amount to brokers to induce persons to emigrate, their aim being to procure as many as the ship can accommodate, as in the case of cargo.
>
> With the exception of emigration brokers there are no other known means adopted to promote emigration in this district. Of course there are many passages prepaid by friends in the United States. There is no strictly pauper emigration from Sicilian poorhouses, so far as I can learn.

Passing from the south of Italy to the north, Genoa furnishes interesting subjects for study in connection with the movements of population. Genoa is the point of embarkation of emigrants to South America largely. The movement was enormous in 1888 and in 1889, but this year it has fallen off very materially. The consuls representing various countries in South America furnish me the following interesting data of the movement of the Italians in the directions indicated:

Year.	Adults.			Children.	Total.	Destination.			Total.
	First and second class.	Third class.				Brazil.	River Plate.	Chili and Peru.	
		Men.	Women						
1888	4,439	79,650	44,202	47,811	176,102	102,424	73,463	215	176,102
1889	3,680	66,634	21,579	20,361	112,254	16,975	95,152	127	112,254
1890, up to March 31	602	9,886	3,560	3,323	17,371	1,551	15,808	12	17,371

For 1888 and 1889 South America received more than four times more Italian emigrants than the United States; but in 1890 it is likely that the United States will receive as many emigrants from Italy as the South American States, and possibly more, inclusive of Sicilians.

There is no emigration to the United States from Genoa. The ships carrying passengers and emigrants to the United States from Italy clear only from Naples and Palermo. There has been no emigration to the United States from Genoa for years.

The consuls at Genoa representing Brazil, Chili, Paraguay, Uruguay, and the Argentine Republic, state that the Italian emigrants going to those States are mostly illiterate and of the unskilled laboring classes, with a few mechanics. The Government of Chili seems anxious to obtain such people in order further to develop the resources of that country, and to that end Chili advertises to pay seven-eighths of the emigrant's passage and either find them employment or give them a certain tract of land to cultivate on arrival at their destination. The money advanced to the emigrant must be repaid by him in two years in semi-annual payments without interest. The number of emigrants from Genoa to South America for three years preceding the record in the above table was as follows:

Year.	Men.	Women.	Children.	Total.
1885	44,632	13,021	13,047	70,700
1886	28,431	10,575	10,135	49,139
1887	55,697	21,089	21,089	97,875

Both of the above tables show a large contingent of families. More than half a million persons have left Italy within five years for South America through Genoa alone. Six large fleets of steamers have been employed in this business. The number of Italians who emigrated to South America in 1889 was as large as the aggregate of English, Irish, and German emigrants together in that year passing through Castle Garden, and in 1888 the Italian movement was comparatively as well as absolutely greater. It is evident that the Latin emigration to the Southern American continent is destined to important results if it continues at all as it has been progressing in the past five years. Already much of the river traffic in South America is in the hands of Italians, who, as a rule, are superior to the races that loiter life away in those Republics.

There is no emigration direct to the United States from Genoa, as already indicated, but there is somewhat of a movement of Italians through Genoa to other ports whence they embark for our country. For example, the agents of the French Transatlantic Steamship Company at Genoa the past five years have sold to Italians annually from 3,000 to 5,000 tickets for the United States, about 10 per cent. of which are prepaid in the United States. These emigrants are furnished with railway tickets to Modane, on the French frontier, where agents of the Transatlantic Company meet them, forward them thence to Havre, and from Havre to New York. It is possible that by this route many subjects of Italian military service slip out of Italy and find their way to Havre and thence to New York. The Italian emigrants via Havre are from the provinces of Piedmont, Lombardy, and Venice.

Genoa is the city to which all seekers from northern Italy after new homes flock, especially in the spring months. These pilgrims neither

look nor act as intelligent as the Genoese, who are the brightest of all Italian populations. The Genoese do not emigrate.

The Italian emigrants from Genoa leave Italy with the view of making money enough to return and start anew in Italy. Those emigrants who go to the United States from northern Italy through French and German ports as a rule are traders or peddlers, given to getting on with their wits. In shrewdness they equal any class of traders in the world. An old Genoese proverb embodies the outcome of their practical maxims. They say, "It takes six Jews to make one Genoese."

Yet the American consul at Genoa, alluding to the Italian emigration from the north of Italy to the United States, gives his judgment that the majority of these will be "desirable additions to our population," and he is confirmed in this opinion by personal acquaintance with Italians who have lived in California, New Orleans, and Memphis, who are now in fact "living under their own vines and fig trees in the town of their nativity." Evidently the allusion is to Italians who have made money enough in the United States to return and buy a part of Italy. Some observers might regard such cases as an illustration of the ability of Italians to get on in the world at our expense.

There is no evidence that in the consular district of Genoa padrones or others are engaged in importing Italians to the United States for speculative purposes. Our laws have had a healthful moral influence on emigration; they have made the agents more cautious; have driven the worst adventurers out of the business, assisted by Italian law; and, best of all, have enlightened the emigrants themselves.

The banking house of Dapples & Co., in Genoa, receive many orders from Cantoni & Co., New York, to remit small sums of money to certain people in southern Italy, but none are received for families in northern Italy. Sometimes a single letter from New York contains orders for remittances to thirty or more families.

Regarding Genoese emigration a representative of one of the steamship lines remarks:

> The emigrants hence to South America generally engage in small farming or gardening in that country. Peru and the Argentine give emigrants land and other aid to start in life. These emigrants are not quarrelsome and make good citizens. The rates for emigrants to the United States via Havre are very low, the railways competing for the traffic as they do in the United States. It is argued that the roads can carry a ton of live freight that loads and unloads itself cheaper ton for ton than goods which have to be handled by railway porters and at railway expense. Hence Italians are moved across France, Germany, or Belgium at very low rates. The competition for emigrants is so active as to form a very important factor in swelling the numbers of emigrants.

Many seamen, masons, and gardeners go from the north of Italy to the United States. Italy has swarms of crude masons, as all the cabins, not to say all the houses, are built of stone, brick, or concrete.

Genoa has the spirit and push of northern cities. One thousand English steamers touch here or land cargo here every year. The province

is poor agriculturally, but through the port of Genoa nearly all the coal consumed in great sections of Italy comes from English mines. As a natural consequence of this great ocean traffic, at Genoa center people of all climes. It is said the city is never free from smallpox. Although there is no good reason, from its situation, why the city should be unhealthy, imported disease fills its hospitals and imparts a cosmopolitan variety to the ailments therein. Yet I could not learn that leprosy prevailed to any noteworthy extent.

Regarding the South American contingent, a Genoese emigrant agent remarks:

These Italian peasants who pass through our hands, sell all they have in their native villages, to raise their passage money to South America. Sometimes they have 10 francs left over. They pay perhaps 200 francs to the agent; the ship gets 160 to 180 francs.

The American vice-consul says:

We have small pox in Genoa much at times, notably two years and a half ago; but the pestilence is raging now but little. I have never heard of a case of leprosy in Genoa. Emigrants are vaccinated before sailing. The emigrants hence used to come from near the cities of Italy, but now they are almost wholly rustic. The children are better educated, as we have had compulsory education for five or six years. The Italian government is not so strict as formerly in its execution of the laws against emigration, because the authorities have discovered that a rigid enforcement of the prohibition drives Italian emigrants across the frontier and other countries get the benefit of transportation business. Many young men, it is said, cross the frontier on the sly, to evade military duty, and are next heard of in New York or San Francisco. This class almost never return.

The Italians who go to South America generally expect to return; but many of them are unable to return, being bonded to the soil. They go to a climate much like Italy, and to a tongue which they can acquire much more easily than English on account of the Latin comradeship of Spanish and Italian. The emigrants who go to Brazil are not so well pleased, as the climate does not agree with them. The emigrants go as a rule to Buenos Ayres, Rio Platte, and Montevideo, and thence are dispatched into the interior. There are Italian societies which protect the emigrant who falls into distress in South America, and take care of him until he can get work. This Italian exodus began thirty years ago, but it was not extensive until ten years ago, since which date it has been very large. Formerly the emigrants went by sailing vessels, enduring great hardships. The emigration to South America the present year probably will be much smaller than for most of the years of the decade.

The exports of Italian products to South America naturally have increased immensely since 1880. At the quays great steamships are always being loaded for South American ports, carrying wines, macaroni, cheese, and other Italian products. One of the chief articles of export hence is vermouth.

A sketch of scenes on the quay at Genoa a few hours preceding the departure of an emigrant steamer for Buenos Ayres, is not without significance. Here, for instance, are two boys, smart and bright, going on their own hook to South America to seek their fortune. They are twelve and thirteen years of age respectively. All their property is contained in a dirty manila bag slung on their backs. One of them

reports that his father is at work in a distillery in Brazil. Their journey will consume about a month. They have each two or three francs in money.

A load of emigrants just from the country packed like cattle in fourth class cars, without seats, is arriving, and they swarm on the quay. The steamers do a profitable business. This ship is now loading with wine, macaroni, dried fruits, sulphur, olive oil, liquors, straw paper. This steamer will take 800 emigrants to Buenos Ayres beside heavy cargo. One of the emigrants has been in South America and is now returning. His story is somewhat as follows:

I have been at work in a brickyard. I have taken the contract to make brick at a fixed price per one thousand. I manage to make 15 to 20 francs a day. My family is here in Italy, but I shall not take them to South America, but shall return here, after I have made more money, to settle again in Italy. I have work all the year and work half a day each Sunday. The Italians in South America have to pay large prices for desirable land. Speculators filch lots of money out of the emigrants, but they give them plenty of time to pay for the land. For a small plot of land for garden near the cities about $125 is charged. Garden land farther from market sells at $40 or $50 for a half acre. The small farmers raise potatoes, wheat, maize, and onions. The land where I am does not need irrigation and is rich.

Bivouacked on the deck are groups of women and children, soaking bread in red wine and lunching amid their bundles and potted plants which they are taking with them to their new homes. Their poverty would be pathetic if they were not so happy in its midst.

The efforts of the South American nations to win emigrants by artificial means, by bounties, and other similar means, have resulted in creating a great movement, but as a rule it is a disappointing one for the emigrant. Want of stable government and institutions, want of a market for products, is the bane of agriculture in most of the South American States. There is plenty of land but no demand for the products of the farm outside of the farm. Hence farming is primitive, of necessity. Peru has made special effort in Great Britain, France, Belgium, Switzerland, Germany, Sweden, and Norway, as well as in Italy to secure colonies. The Government of Peru has spent as high as $100,000 a year to encourage emigration and distribute it on irrigated land owned by the nation. The government has distributed free passages; but the emigrants find themselves worse off in some respects than at home. One colony of Italians in Peru have had to fight for existence against the Indians and half-breeds. Peru gives 250,000 square meters of land to every able-bodied settler who will bring it into cultivation.

The value of stablity and of moral forces is overlooked, and hence South American immigrants as a rule want again to emigrate. Add to political chaos and social insecurity want of industrial diversity, and you have certain conditions far worse than those of the Old World, where stable government guarantees many of the essential conditions of happiness and prosperity. The service of society to man is far greater

than that of any man to society. In 1888 over 250,000 Italians returned from South American States to Italy, reflecting very forcibly the influence of the conditions that have already been outlined.

The Venetian province sends the largest contingent to the South American States. Cuneo, in Piedmont, on the French frontier, sends the largest temporary emigration, perhaps because at such points it is easy to run away from military duty.

A SIDE-LIGHT ON ITALIAN EMIGRATION.

I have already alluded to the presence in Italy, the present year, of Mr. Landis of New Jersey, a student of Italian agriculture and an exploiter of Italian energy in the United States. The following sketch of a conversation with him in Genoa is of interest because it sheds some light on the difficult problems of American life. The anomaly of starving or hungry and greatly congested metropolitan populations within a few hours of idle and productive land is a menace both social and industrial, and a menace especially in a free republic. The most populous square mile of territory in the civilized world is said to be that square mile in New York City which is the focus of Italian life in the United States. That they manage to subsist, some sociologists argue, vindicates the right to be there; but Mr. Landis's experiment seems to prove that life is more than subsistence, and that when congested populations will not go to the land, genial and successful means may be employed to bring the land to them.

As the problem of civilization at the opening of the present century was how to bring a loaf of bread and a hungry mouth into coincidence, the problem of the close of the century is how to bring to the land the hand which represents that hunger. Steam has made civilization metropolitan. Already about 33 per cent. of the population of the United States is urban and half of the balance seems baffled because it also can not be urban. The momentum of consolidation, of great capitalization, of massed manufacture is irresistible. Can anything be done to extend the domain and the variety of agriculture? Are small farms going out and must land monopoly come in? Momentous questions which threaten the governments of Europe can more easily be solved in the United States by avoiding the conditions which lead to land monopoly. It is possible that the operations of the Italians on land a few hours from New York may furnish a clue to the partial solution of a problem in advance of its existence. As will be seen Mr. Landis is an admirer of the Italians, it may be in excess; but I subjoin the substance of what he has to say:

There are 40,000 Italians in New York and 20,000 in Philadelphia, but it is said there is hardly an Italian prostitute in either city. The Italians have large families. In the settlement of Italians at Vineland, N. J., there is a population of about 1,000 Italians—from six to twelve persons to a family. There are in this Italian colony 200 owners of land. Their farms average about 20 acres each. I sold the land on

credit mainly. The occupants invariably pay for their places and get on well. Since 1871 these Italian families have averaged about $20 each in increase of wealth, so that to-day their industry since 1871 (a period of about twenty years) represents an aggregate of $400,000. There is not an Italian in my county in an almshouse; there is not an Italian beggar in the place. Many foreigners go to cities and stay there because they are unaware that cheap land is so near, not only New York, Baltimore, and Richmond, but so close to the great manufacturing towns of New England. In Vermont and Maine there are many idle farms, much unoccupied land available for production.

I am aware that New England is too cold for Italians; but it is just the place for Scandinavian emigration, not to say emigrants from the north of Europe in general. Small farms pay well in the Central and Northern and Eastern States. In New Jersey alone there are a million and a half of acres of uncultivated land that might be made to bud and blossom. The soil is sand and clay, the best fruit and vegetable land in the country. This soil grows sweet potatoes at small expense, fetching more per bushel than wheat. We grow 150 bushels of sweet potatoes to the acre, while 20 bushels of wheat is a fair average per acre.

I make bold to say that there are fifty millions of acres of land available for garden crops, vegetables, and fruit, located within available market distance of New York, Boston, Philadelphia, Baltimore, and Washington. The idle population of our cities don't believe it; don't know it; and yet four-fifths of them were raised on the farms of Europe. The immigrant is quite unaware that there is any chance to get at the land east of the Wild West.

The Italians are chaste, industrious, and saving. They have good blood. They are clean farmers, painstaking, and know how to make both ends meet and lap over. They grow peppers, radishes, early onions, and so on for the New York market; they can't get such crops in the West, or if they did, they wouldn't find anybody to eat them. There is nothing for the poor man in wheat farming. Big farms and machinery for bread; but small farms and hands for dessert. Twenty bushels of wheat at 40 cents a bushel is starvation for the poor man. Rich men can farm on low prices for cereals but none others. The poor man's future on the land lies in painstaking care of small plantations that give variety and interest to the dinner table. The Italians are successful because they understand small farming, the vine, fruit-growing, economy of manures and clean culture. They have wisdom as to soils and crops, and take off two and sometimes three crops a year in succession. Behind them they have 30 centuries of agricultural experience. They waste nothing. The apples which others turn over to swine or suffer to rot under the trees, are daily pared and dried under the trees. They cultivate no weeds, but use all their land. The twigs which they prune from the trees are burned or buried by the roots of their vines to feed the grape crop.

You may well imagine that the aggregate product of these 4,000 acres cultivated by this Italian colony in Vineland is enormous. The colony give the police no trouble. There are no brawls, nor does drunkenness prevail among them. They speak English, the children, as a rule, fluently; and they become citizens and vote—some one ticket, some another, though the Democrats work them most. If the States which have idle lands should put into the hands of emigrants arriving in New York a fair statement of opportunities for settlers, I believe the congestion of population in our cities would be relieved, and the dangers of land monopoly further removed.

Take the history of Vineland, in New Jersey, as an illustration of what may be accomplished in the direction indicated: A quarter of a century ago I bought (continues Mr. Landis) 72,000 acres of land in New Jersey. People forget that it is the best land which is likely to be used last, because the best land can only be made available by spending money upon it, underdraining and sweetening. I took these 72,000 acres of land and put 14 miles of canals throught, it for drainage. Soon in one center, a manufacturing settlement sprang up with fifty-three distinct enterprises, supporting a population of 6,000 persons. There are now twenty schoolhouses at

that center, a boys' college, and to-day a population of 12,000 may be found where twenty-five years ago there was a wilderness, groaning for a John Baptist of industrial prerogatives.

The country produces not only good crops, but furnishes the material, sand, and clay beside each other, for brick. From twelve to sixteen cars, in the fruit season, are daily loaded and forwarded to New York—berries, peaches, apricots, in their succession. It is a great poultry and egg producing region.

The lesson of my journey in Italy is that the Italians are good farmers, steady, sober, and industrious. The sense of art, which is powerful in the Latin race, crops out even in their agriculture. I call them beautiful farmers. Their cottages are tastefully treated and their interiors are attractive; their agricultural utensils are primitive, but they move forward on touching land in the new world. One-half the Italians in the Vineland settlement can read and write. The women, as a rule, are handsome.

There is five to ten times more profit in small farming near large cities than in large farming in the west, dollar for dollar; and they need not shrink in the presence of competition; for that makes people reasonable, just, and sensible in affairs. The Italians in Vineland were not swarmed; they came family by family; one attracted another; they were not selected but self-selected. In Vineland about 400,000 gallons of wine are now produced annually by Italian and other farmers, and these small farmers manage each to save on an average $250 to $300 a year. They used to work in Italy even into the night; now they have shorter days and a surplus instead of long days and hunger.

The ease with which foreigners coming to this country, mix with our population is forcibly proved as every ship arrives in our ports. One may see the Italian scissors-grinder set up business five minutes after touching our shores. If he has any impressions of America, he does not stop to write a book before proceeding to business. He is unimpeded by baggage, and has nothing to bother him except his apparatus for putting an edge on things. Light-hearted and gay, he does not bother himself with looking for a boarding house, but oils up his machine, rings his bell, and calls into his empty pocket the dimes of the New World. He gives the police no trouble; the criminal statistics of New York City show a diminution in the arrests of foreigners—only 794 Italians out of a total of 20,000 arrests in the last quarter of 1889—and these mainly for petty offences. Of these 794 arrests of Italians, but 17 were women. The Italians of New York City, in some respects, may not be a very desirable fraction of the population, but it does not appear to be disorderly or dangerous. The little knowledge of the anarchist is more dangerous than the industrious ignorance of the Latin race.

The age of steam and of electricity has thrust upon the brawn of the world so many novel burdens and on its brain so many weighty questions that both muscle and nerve are in dilemmas. The number of Italians in New York City is larger than the army that achieved American independence. Prior to the war of the rebellion an Italian was a curiosity in American populations. The disappearance of servile labor from the United States was a loud call to European masses, and they heard the call. In 1875 there were almost no Italian emigrants to this country; in 1888 alone, nearly 200,000 Italians swarmed to our shores. In some years as many as 100,000 Italians have returned to Italy from

this country, but in many cases only again to reappear on our shores with their wives and children. The tendency, however, is to diminish return passages from this country to Italy. In 1888 there were but 6,331 immigrants migrating to Italy, while in the same year nearly a quarter of a million of the same people left South America for their old homes.

The severe agricultural conditions in Italy are not the only cause of Italian emigration. Overpopulation is an active cause. Italy is the most populous country in Europe, and 30 per cent. more populous than France or Austria. Italy in recent years has sent to the United States about the same ratio of emigrants to population as Great Britain and Ireland, but more than three times more than the German ratio, yet Italy is sending to all foreign countries less than 33 per cent. of her natural gain of population in excess of births over deaths; in other words, Italy is parting with a quarter of a million of her people, more or less, annually, and yet is increasing in population half a million a year. This looks as if emigration is not the remedy for overpopulation. It is likely, as the pressure of population is an important cause of wars, that the exodus from the Old World to the New is a chief source of the unexpected delay in the tremendous conflict for which European states have been getting ready since the close of the Franco-Prussian war.

The population of Italy is about half as large as that of the United States in a territory matched by single States of our Union. The largest permanent emigration is from the Province of Turin. From Lombardy permanent emigration also tends to increase. Calabrian emigration also increases, but arrivals from Tuscany are diminishing. It is an interesting fact that hardly an emigrant in the United States is from Latium. Rome sends us absolutely no Romans, old or young. It is a fact suggestive of the powerful hold on the cellars and attics of crowded European cities, that, although Naples is the most densely populated city in Europe, many a village of Calabria sends to the United States more emigrants. This is the average of the metropolitan movement from Italy: Rome, none; Venice, none; Naples, 800; Turin, 1,500; Genoa, 180, annually, to all points. It is not the cities which are contributing to the cities. It is the world's land that, for one reason or another, is forsaken. The fall in the prices of agricultural products, it is evident, is not an adequate reason if it be one reason; steam and electricity, gregariousness and concentration, consolidation and big fish, are among other causes conspiring to impose setbacks on country life.

The promotion of small farming is both an economic and a social obligation, and legislation in harmony with natural law for the improvement of the conditions of rural life, it would seem, is one of the imperative duties of contemporary lawmaking bodies. The problem of immigration grows more perplexing as farms grow larger. The industrious and honorable emigrant becomes a valuable addition to the national

economy as farms grow smaller. By the best utilization of man nature gives back the most, and equality tends to supplant inequality or justice to follow injustice in the distribution of wealth. If we allow the problem to grow more and more complicated, ere many years all political questions will have become economic and class bias will menace both political and industrial order. There are advantages in small farming in an epoch of concentration and steam, because chickens can not be made by machinery, and hence the legislator on the side of rural life has nature with him.

The Japanese have a proverb like this: "The more you know of earthquakes the less you like being left alone with one." In nature the throes are unavoidable. In economic and social life the political seismometer is prophetic and one may prevent by wisdom the catastrophe which unwisdom precipitates. The more one knows of the anarchic forces that menace European society the less he cares to be left alone with them. Sitting on the safety valve while combustion increases is not the wisdom of business. The safety of modern states is in fact the maintenance of a healthy proportion between urban and rural life. Small farms have saved France from chaos. They are to-day the groundwork of our republican stability. Remove the stimulus to ownership of land and you remove the incentive to effort. The man who owns a house and 20 acres of land never becomes a propagandist of the pernicious heresies which to-day are honeycombing Germany and Italy especially. Our homestead law was fine wisdom; but students of legislation can find no more important field for useful study than the study of the problem of the successful propagation of 20-acre farms in the United States. There is no limit yet in sight to the productive capacity of an acre of land; the author of "Twenty Acres Enough" was wiser in his generation than many of us are in our regeneration.

FRENCH EMIGRATION.

The famous chapter on "Snakes in Ireland," which began and ended with the declaration, "There are no snakes in Ireland," might well be substituted with the necessary verbal changes for a chapter on French emigration. But two ports in France are conspicuous as ports of departure for emigrants, and from these ports the great majority of departures are of nationalities other than French. The fact that France is the only country in Europe conspicuous for small farms, no doubt, has a close connection with the contentment of French agricultural population, which is a unique fact in European life—discontent being the chief course of emigration. French cities send few emigrants, in this respect resembling all other cities. Paris possesses the most varied industry of any city on the globe, but it is a mistake to say that Paris is France. The French peasant and farming class is France, whether there are bills to pay for a new war, or an indemnity for an old war, or public credit and prosperity to maintain. In small farms and diversity of industry reposes the stability of French civilization in the midst of political fermentations.

From Havre in France about 25,000 emigrants annually sail for the United States, and only about 10 per cent. of these are French. From Marseilles from 3,000 to 4,000 sail annually for our country, and only a handful of these are French. The Italian emigrants are in a great majority both from Marseilles and from Havre. A more particular study of the statistics is of interest:

Emigration from Marseilles.

Nationality.	1888.	1889.	Total.	Nationality.	1888.	1889.	Total.
Italians	2,290	1,491	3,781	English	10	5	15
Syrians	487	942	1,429	Swiss	17	12	29
Russians	52	37	89	Egyptians	7	1	8
Turks	20	73	93	Roumanians	.....	38	38
Greeks	405	98	503	Portuguese	.....	2	2
Spaniards	21	16	37	Belgians	7	1	8
Armenians	65	207	272	Poles	.....	2	2
Americans	15	38	53				
Austrians	11	21	32	Total	3,415	2,987	6,402
Germans	8	3	11				

Emigration from Marseilles—Continued.

DESTINATION OF EMIGRANTS.

Year.	French.					Total.	Foreigners.								Total.
	New York.	San Francisco.	Quebec.	New Orleans.	Boston.		New York.	San Francisco.	New Orleans.	Chicago.	Quebec.	Baltimore.	Boston.	Philadelphia.	
1888	53	2	....	2	6	63	2,730	37	508	79	....	50	11	.....	3,415
1889	44	2	....	10	1	57	2,298	7	47	16	....	34	6	579	2,987
Total	97	4	....	12	7	120	5,028	44	555	95	....	84	17	579	6,402

Occupation.	No.	Occupation.	No.	Occupation.	No.
Horticulturists	183	Bricklayers	82	Day-laborers	1,415
Coopers	89	Blacksmiths	97	Clerks	362
Shoemakers	271	Stokers	82	Wheelwrights	83
Agriculturists	634	Navvies	548	Miners	427
Coachmen	17	Bakers	53	Fitters	42
Cooks	41	Painters	27	Housekeepers	203
Tailors	62	Weavers	31	Without trade	1,257
Joiners	71	Carpenters	82		
Machinists	147	Locksmiths	54	Total	6,522
Masons	.....	Cabinetmakers	41		
Butchers	17	Lithographers	32		

SEX—DIVISIONS.

Year.	Men.	Women.	Children.	Total.
1888	2,895	307	263	3,465
1889	2,390	412	255	3,057
Total	5,285	719	518	6,522

Perhaps the most discouraging feature of the statistics from Marseilles is the decided increase in the oriental movement—Syrians and Armenians. If that movement should continue to increase at the percentage of increase for the past two years it would steal upon us with disagreeable surprises like that which it was found necessary to checkmate from China. There is almost no French emigration from Marseilles, less than 2 per cent. of the emigration from that port being French. The strong predominance of Italians and of men in the list of emigrants from Marseilles indicates that the military refugees of Italy find Marseilles a convenient point of flight.

An encouraging feature of the emigration statistics from France, on the contrary, is the fact that about 50 per cent. of those, at least, who sail from Marseilles are men of skilled or half skilled trades, and that in great variety.

The total emigration of French to this country in 1889 was but 2,827, exclusive of first and second cabin passengers, who probably would swell the aggregate to 4,000. It is evident that the question of French

emigration from France is of small importance to this country compared with the increasing French emigration from Canada. For example, in 1890, about seventeen thousand French Canadians passed through Island Pond, Vt., the chief point of emigrant passage on our Canadian frontier; that is, we get more than four times more French emigrants from our English neighbors on this side of the sea than we do from France on the other side of the sea.

From Havre the following more detailed statement is of interest in this connection. The emigration to the United States from Havre in 1889 was 25,083; in the first five months of 1890 it was 14,073, indicating no great variation from that of 1889. The emigration of 1889 consisted of 2,770 French, and 22,383 of other nationalities. A few of these emigrants went from Havre to New York via England, but most of them sailed by the French steamship line direct from Havre to New York.

Very little if any contract or pauper emigration to the United States is discoverable in the French ports. The strong impression in Europe in general is that the United States is not the normal home of tramps. Our legislation and the occasional return of prohibited emigrants are well understood among the poorest classes in Europe. The French anarchists are not so inclined to leave France as Germany, and the retirement of Bismarck is likely to diminish the Teutonic movement of this class of people, in the absence of further extension of the German anti-Socialist laws. The chief bait for emigration through French ports is low steerage quotations in combination with cheap overland rates.

There is no indication that the Mormons are doing any recruiting work either in Italy, France, or Germany.

The risks of contagious diseases reaching the United States from Havre are trifling; from Marseilles they are more grave. Leprosy hardly has an existence in France to-day.

The emigrants from Havre as a rule are a young and healthy class, men being in great majority and laborers from the north of Italy predominating. Many of the emigrants, particularly the French, carry with them $150 to $250 to start in life on in the New World.

It will be found important, I think, if accurate statistical information is desired concerning foreign immigration, to pay more attention in the future to the second and first cabin. Hitherto we have counted the steerage or third-class only, but there are coming to our shores a very thrifty and valuable class of emigrants from all parts of Europe in the second cabin, and a limited number in the first cabin also. In my account of Dutch and German emigration this fact will be illustrated, but it is also illustrated in French emigration. On the other hand, many American sailors and some unfortunate or economical travelers seek the steerage passage to the United States. Last year in the emigration statistics from Havre were included nearly 1,300 Americans, mainly workingmen and mechanics in care of the American exhibits at the Paris Ex-

position; but of course this factor of the statistics for 1889 is exceptional. In 1889 the French steamship line from Havre to New York carried 9,830 first and second class passengers from Havre to New York City, none of whom appear in the emigrant statistics, though unquestionably at least a small per cent. of them belong therein.

This glance at French emigration would be wholly inadequate, however, if mention of the emigration from Havre to points outside the United States were omitted. In 1889 the total emigration from Havre to all points was 49,856. Of these 11,728 sailed to the Argentine Republic, and 617 to Brazil, while Canada got but 239. More than two-thirds of the French emigration in 1889 went to South America, encouraged by the advances of passage-money and by promises made by the agencies established by the Argentine Republic in France. The business of transporting emigrants from Havre employed in 1889 169 steamships—114 French, 47 German, and 8 British. These vessels sailed as follows:

New York	90
Brazil	32
Buenos Ayres	31
Colon (Aspinwall)	9
Canada (via Liverpool)	7
Total	169

In this connection further details of the French Canadian movement are timely. Our collector of customs at Island Pond, Vt., estimates that the French Canadians passing our frontier through Vermont from Canada the present year will be about 17,000 and he believes that about 16 per cent. at least, of these will return to Canada, having no intention of becoming permanent residents. This was true, as a rule, of French Canadian emigration at the outset but the tendency is for an increasingly large percentage of them to become permanent dwellers in our country, in the manufacturing cities of New England especially. Most of the French Canadians leave Canada on account of the pressure of poverty and they probably will not average to possess 5 per cent of the purse when they enter the United States which they possess on returning to Canada. Five dollars is probably the average money which the French Canadians possess on entering the United States. Practically all the French Canadian emigration enters American territory via the Vermont district. The past year about 8,000 emigrants other than French Canadians have entered the United States from Canada through the collection district of Vermont.

In France population is now nearly stationary, but the cities even of France are growing in population, while in the rural districts population is slowly receding. Of course in these facts lies one explanation of the paucity of French emigration as well as of the difficulties in the way of French colonization to which France is now looking to cure the mischiefs of declining exports. Everything is now being manufactured all over Europe. France is in a position alone to make shoes enough

for the whole human race. They who want to make shoes are in great disproportion to those who want to wear shoes. The magic of manufacture by steam and invention outdoes the prodigies of the Aladdin lamp. It is in the better development of the land that safety of commerce and the security of States resides. Cities are civilizers, but countries are humanizers. It is a touch of nature that makes all the world kin. Landlordism repudiates nature. Titled foreigners now own 21,000,000 acres of land in the United States, besides vast tracts owned by untitled foreigners and great American proprietors. If we are going to have the small farms of France and of New England in the West and in the Southwest, and development along healthy and normal lines, we can not leave things to drift, for the drift of all the ages hitherto as to land has been anti-social, anti-republican and landlordly.

France furnishes a unique example of cosmopolitan tendencies. Her population in the last ten years has increased by about a million, of which 777,000 came from other parts of Europe, so that the French, like the Americans, tend to become an amalgam of English, Germans, Flemings, Italians, and Spaniards on a French base. French families are the smallest in Europe. There are more additions to the French by immigration than by birth. French manufactures were upbuilt under Colbert by importing skilled workmen from other parts of Europe. The foreigner really is at the basis of French superiority in manufactures; for the policy of assembling the best workmen in France has instructed the best workmen. The foreigner upbuilt English manufactures, and French religious exiles founded the linen industry in Ireland. France saved herself industrially by importing skilled labor and later on by religious persecution forced an emigration which proved as much of a blessing to other lands as her immigration had proved to France. Impertinence toward intelligent labor, native or foreign, is a grave economic blunder.

The French Government is neutral, so far as its official policy concerns emigration, but its indirect influence on the press reënforced by public opinion, is toward the discouragement of emigration. Discouraging reports from foreign countries get extensive circulation and the worst side of things abroad is emphasized. France each year seems disposed more and more to encourage immigration. There is some friction between the French and Italians in French cities, as the latter are taking possession of the field of unskilled labor, particularly in Marseilles, where it is estimated there are 60,000 Italians (about as many as in New York City) who live cheaper and work at lower rates than the natives. Italians in France work for about 50 cents per day and live on Indian meal, bread and vegetables. Wages in general are about half as high as in the United States and the standard of living correspondingly lower.

There is a small movement of skilled labor from France, valuable to our industries because the silk weavers, designers, dyers, machinists,

and other skilled workmen represent a certain artistic development, of which, in my judgment, American industry stands in especial need.

The supervision of French emigration is slight, but the French supervisor asks intending emigrants questions regarding their means of subsistence if they get no work abroad, and attempts to dissuade such as are likely to fall into want from emigrating. French emigrant agents are under strict supervision, and their occupation is gone as soon as they are convicted of making false representation or of fraud on the emigrant.

The French Government enforces strict regulations for the protection of emigrants on ship and one article of the French law prohibits the admission of any emigrant into France unless he has goods or money worth $40 for each adult and $16 for each child.

Since in one, or at most, two days, the past year more emigrants have sailed from Italy for the United States than from France in the whole year, French emigration is only of casual interest. The French who are coming to us, tend largely to go South where French is spoken, although many remain in New York. A considerable increase in the emigration of the French skilled worker would occur but for the bar of poverty and of language. The French are intensely patriotic, which is another dissuasive from emigration, and this dissuasive is punctuated by native deficiencies in linguistic talent. The Germans are natural linguists and absorb English with great ease, but the French find English pronunciation and orthography an almost insuperable barrier to ready amalgamation with our race. But as already indicated, an increase in the emigration of the French manufacturing classes could not fail to raise the æsthetic standard of our textile production which, it would seem, should be our present industrial ambition in an age when half of the value of the product lies in its beauty.

BELGIAN EMIGRATION.

Belgium, according to area, is the most densely populated country in Europe. The language is a bar to emigration, as it is in France, and other conditions which diminish French emigration also operate in Belgium. The fine subdivision of land in Belgium explains the density and general content of a population which otherwise would be excessive. There is as much immigration as there is emigration. Wages in Belgium are very low. In the agricultural districts men average 40 cents and women 25 cents per day. The demand of the best young men for the army probably is one of the causes of the extensive exploitation of female labor in the fields of Europe in general. The style of living of Belgian wage-workers is greatly inferior to that of workers in the United States. Much smaller farms obtain in Belgium than in any state in the world, but the misfortune is that three-fifths of the land is occupied by tenants.

Of 518,000 acres, 143,000 are in forest, 188,000 occupied by owners, and 283,000 by tenants. Over 40,000 acres of land are owned by the state and the communes. The annual rent of land per acre in Belgium is four to five times the average purchase price of new lands in the new countries of the United States. Of course, agriculture in Belgium is very primitive, and its profits are diminished by the distance, often considerable, between the cottage of the tenant and the land or separate plats of land which he cultivates. There are more workers of all classes in Belgium receiving 40 cents a day and less than in excess of that figure, while almost none receive 80 cents and upwards. Intemperance is more prevalent in Belgium than in France, and discontent among wage-workers is frequently quite radical and turbulent.

Formerly there was small emigration through Belgium to the United States, but since the improved service offered by the Red Star Line quite a large movement of emigrants from other states than Belgium has set in, without, however, any emphatic increase in Belgian emigration itself. Only about 12 per cent. of the emigration from Antwerp at present is Belgian, and as a rule these are not agricultural workers so exclusively as the emigrants from other European states. Some glass workers and experts in iron and steel manufacture, miners and others, are now emigrating from Belgium to the United States. A large proportion of the Belgian emigrants flow into Pennsylvania; some go to New Orleans.

There has been a considerable decline in the South American movement from Antwerp, coördinate with a similar falling off in the general European departures for the countries of South America. Below is a table which is self-explanatory.

Emigration from Antwerp by direct steamers.

To—	1889.	1888.	1887.	1886.
New York	22,050	24,849	25,350	17,089
Philadelphia	3,860	3,861	4,770	1,385
South America	11,434	6,018	1,017	1,131
Australia	1,735	838	2,257	1,949
New Orleans	211	514	350	491
Boston	1	8	12	.....
Montreal	.....	.....	18	4
Cape Town	7	.....	.....	.....
China	.....	10	19	.....
	39,298	36,098	37,793	22,040

In 1890 the emigration through Belgium does not promise to vary much from that of 1889, but its direction has undergone some change, due to the decline in the South American current. For six years beginning with 1880, when the emigration through Antwerp first became noteworthy, about 150,000 emigrants sailed from that port for New York, of whom less than 10 per cent. were Belgians; 18,079 sailed for Philadelphia, and 872 for Boston, and 2,300 for New Orleans. The foreign population of New Orleans is increasing to no small extent from the Latin and Gallic races of Europe. There is also a small movement into Texas from these same races, the object of the French contingent being the culture of the vine. The present indications are that the development of agricultural enterprise in the southwest, and to a certain extent in the South, is to be secured through an increased movement of emigrants from southern Europe, where climatic conditions closely resemble those amid which they were reared.

Of the departures from Antwerp 33 per cent. and upwards average to be Germans. The Swiss average nearly as many as the Belgians, and it is a curiosity of the statistics that more English than Belgians sail to the United States from this chief Belgian port, an illustration of the fact that competition makes the longest way round the shortest way away from home. In the emigrant list from Antwerp this competitive tendency brings through that port Austro-Hungarians, French, Italian, Luxemburgian, Dutch, and even Russian emigrants, the latter in small numbers. About 33 per cent. of the emigration through and from Antwerp is female.

Representatives of the emigrant interest in Antwerp are responsible for the following statements:

No dangerous class of emigrants, such as criminals, paupers, etc., go from Antwerp, so far as is known. The majority of the emigrants are rustics. The steamship com-

panies employ no unusual means to win emigrants. Every precaution is taken to avoid danger from contagious or infectious diseases. The emigrant lodging-houses are carefully kept and fumigated, and a medical examination is made at each sailing. Last year there was a Belgian rush to South America, but this year there is only a small movement, as many have returned discouraged and dissatisfied.

The agent of the Red Star Line says:

The number of emigrants from Antwerp to the United States from January 1, 1890, to July 31, 1890, was 18,134, against 16,963 during the same period in 1889. [It is evident that the decrease in emigration to the South American States tends at Antwerp, as at Naples, considerably to swell the number moving on the United States.] Our emigrants come chiefly from Germany, Austria, Switzerland, and Belgium, with smaller numbers from Italy, France, and Russia. The peasant emigration is in large majority from all points. We have detected no paupers or criminals amongst our emigrants, and have never met with Mormons, who, if we are not mistaken, sail via England. No cases of leprosy or cholera have been found at the medical inspection, which takes place before sailing by the Belgian health officers. There exist no summer and winter rates for steerage as for cabin passengers.

The steerage rates are subject to changes and are regulated by competition. Formerly there were frequent war rates but for some time the rates have been steady for 90 marks to New York and 80 marks for the smaller ships going to Philadelphia from Antwerp. The number of prepaids depends to a great extent on how the rates in America compare with the rates on this side, as agents and passengers avail themselves of a difference which may exist between these rates respectively. From 10 to 20 per cent. is the usual proportion of prepaids; but there is a margin of uncertainty beyond this in the large number of prepaids which escape the control and knowledge of the steamship lines; we mean the prepaids which are not drawn on the lines, but on agents on this side. Taking these into account the proportion of prepaids may be much higher, but it can not even be guessed.

We have found no assisted or contract emigrants the past year. There were 4,023 steerage passengers returning from the United States, last year, to Antwerp, to visit their various homes. We have a contingent of steerage passengers who are going and coming continually. We have such passengers who have crossed and recrossed six times. There is no Scandinavian emigration through our line.

One of the emigration agents at Antwerp makes the following statements:

Quite a number of Belgian farmers are going to the Far West of the United States this year. They average to take with them 200 to 300 francs. Some have gone to Indiana, some to Missouri, some to Dakota, some to California, and a few to British Columbia. There is some emigration hence to Hull and thence by rail to Liverpool, perhaps 750 persons a year, going this roundabout way to the United States.

The French Commercial Line, starting from Antwerp and calling at Bordeaux for New Orleans, takes out about 600 farmers this year to the southern part of the United States. Many of these are rejoining relatives who have settled in Texas. These people have but 10 or 12 francs, on an average, after paying their passage, being generally "prepaid." Nine out of ten of these southern immigrants are too poor to have gone to the States but for a prepaid passage. If the emigrant takes a letter from America out of his pocket, it is safe to pronounce him a good man.

A look at the steamship ticket books shows farmers, engineers, carpenters, masons, furniture makers, machinists, printers, and dressmakers in this year's emigration—farmers predominating. From 70 to 90 per cent. of the emigration is from the farm.

Emigration from Belgium is unrestricted; no passports are required as in Italy. In winter there is quite a rush of intending emigrants to Antwerp.

Here is a glance at the steerage list of the various ships from Antwerp this year:

Via *Westernland*, March 22, 873: 300 Germans; 40 English; 105 Austrians; 27 Americans; 125 Luxemburgers; 32 Italians; 50 Russians.

Via *Waesland*, March 29: 20 Belgians; 125 Germans; 30 English; 85 Austrians; 19 Italians; 20 Swiss.

By ships sailing from Antwerp March 14 there was about the same proportion of races. In April the numbers were larger, particularly of Germans. On the ship that sailed April 4, twelve nationalities were represented in the steerage.

From Milan, in Italy, to Antwerp, Italians, and other steerage passengers are forwarded by rail for $12, luggage included, and when Antwerp lines are short of passengers rates are sometimes cut to $10 to New York, but the usual price is $21.50.

On April 25 the *Westernland* took from Antwerp 952 steerage passengers, of whom nearly half were Germans, and 112 Austrians and 64 Russians, besides Swiss, Dutch, English, and Italians.

The agent of a line carrying from Antwerp to South America says:

> In 1889 we sent 1,500 steerage passengers to South America by one ship, now we are sending none.
>
> By one ship forty-four Belgians have just sailed for Montreal. Our Russian emigrants come from Odessa and are mostly Jews, a very poor, ignorant, and pitiable lot.
>
> The best emigration flowing through Antwerp is German, and it is about 80 per cent. of the whole. The German authorities try to discourage this movement, and here is a copy of a New York German paper, circulated very largely in Germany, which sharply criticises the course of the United States Government and of the authorities in New York on emigration. But these efforts of the German authorities to retard emigration do not seem to be very effective. The Germans returning from America to visit Germany and the letters of those who do not return are irresistible arguments for emigration. Those who return tell their German friends, "There is no chance for a poor man in the Old World. We've got the best land and the best institutions under the sun in the New World."

It is probable that the measure of the anxiety of foreign governments to reduce emigration to the United States is a measure of its value. The slums of Europe are not to any extent moving on the United States. The slums are stagnant social factors; as a rule they do not flow unless artificially moved, and, so far as I am able to discover, the artificial movement is now confined to the Jewish emigration from Russia and an occasional estray aided by British benevolent effort.

DUTCH EMIGRATION.

Dutch emigration is small, but as a rule desirable. The Dutch are excellent farmers, successful as dairy and stock farmers especially. The Dutch who emigrate are not all mere farm laborers, but many of them are well to do. Quite a colony of Dutch farmers have settled the past year in California, where they have corporate proprietorship of a large tract of irrigated land in Mercer County, which is sold to settlers at $175 per acre. Some of these settlers are said to be worth $25,000, and most of them have considerable means ranging from $1,000 upwards. From 100 to 150 persons have already sailed from Holland, and more are expected to follow.

These emigrants have houses, furniture, barns, agricultural implements, pianos, pictures, books, silverware, and other evidences of the Dutch capacity to get on in the New World, all of which are either owned already or being paid for on the installment plan. They will raise alfalfa, grapes, and other fruits, besides having stock raising and dairy products in view. Teachers for the colony's agricultural needs are employed, and thus new "Rotterdam" of California is without doubt to revive the Knickerbocker prosperity of our Atlantic coast on our Pacific shores. And here it may be remarked that, owing to various causes, perhaps among others to the increasing impression in Europe that the United States desire no emigration that can not help itself, there is an increasing number of well-to-do people joining the movement to the United States.

The movement of European capitalists on American industry as purchasers is one of the most noteworthy and oft-mentioned phenomena of the past year in finance as in population.

Formerly about 3,000 Dutchmen came to the United States per year, but the number within a few years has been fewer, while the emigration other than Dutch through Dutch ports has fallen off decidedly, due in part perhaps to the improved facilities offered by the Belgian and German lines. There is great competition in the various seaports of Europe for rivulets from the stream of emigration. Formerly about 25,000 emigrants a year averaged to pass to the United States from Dutch ports (from 1880 to 1883, inclusive), but the number now averages much less, and of this about 12 per cent. is Dutch, the balance representing other European nations in a ratio not greatly unlike that of the Belgian movement.

From 1880 to 1883, inclusive, the movement of all nationalities from Rotterdam averaged to be about 15,000 annually, of whom about 3,000

were Dutch, but there has been a marked decline since 1883. In 1889 the whole number of emigrants from Amsterdam to the United States was 5,058, of whom 2,490 professed to have skilled occupations. In 1890 the Dutch (direct and indirect) emigration probably will not exceed, if it equal, that of 1889. More Germans than Dutch continue to pass to the United States from Holland, showing that the Dutch have not only taken Holland, but mean to hold it.

Following is a list of emigrants from Amsterdam to the United States prior to 1889, which was given above:

Year.	Total number.	Number with occupation.
1884	4,612	2,204
1885	2,842	1,674
1886	4,647	2,428
1887	8,057	4,183
1888	8,117	4,546

How slight causes operate to promote or to retard emigration has already been indicated. A strike in the United States diminishes the outward movement. A strike in European countries, a menace of war, social unrest, clan persecution, increase the outward movement. It is surprising how soon industrial depression in the United States cuts down the European movement; and how soon European populations hear of good times in the United States. The tens of thousands of letters which come from our country into European homes are a more powerful factor in emigration than is generally supposed.

GERMAN EMIGRATION.

There is no doubt that the abnormal movement of German population to the United States, which the exactions of the military service of Germany generated, was heightened by the blood-and-iron policy of Prince Bismarck, and that the decline in German emigration, which for the first five months of 1890 was 6,000, as compared with the corresponding months of 1889, is due more to the progressive, industrial, and peaceful political policy of the present German Emperor than to any other single cause. There is an absolute scarcity of agricultural workers in Germany, a scarcity so noticeable as to greatly alarm many sagacious German economists. In the harvest and planting seasons the women are now doing a large part of the work; the women raise a large part of the beet-root crops on which Germany relies for sugar, while help at the busy seasons is imported from the neighboring frontiers on the north.

I have myself seen twenty-five women engaged on one large beet-root field, some of these even imported from the Scandinavian nations. The army and emigration have made alarming levies on the rural population of Germany. The Government, during the present year, has established a newspaper whose motive is the diminution of emigration and the exploitation of the colonies. From this paper I shall make certain significant extracts later on. This journal is published by the German Imperial Foreign office.

We have received in the United States about 4,600,000 German immigrants during the past seventy years—a large proportion of that number during the last twenty-five years—and it is conceded that the Germans are easily and advantageously fused with the native stock. In politics they are less clannish than most other immigrant races; in industry they are thrifty, and in character they average well.

The study of the German emigrant may profitably be pursued in the German country, and at the chief points of embarkation, the ports of Bremen and Hamburg. No one who has lived awhile in the German countryside but feels anew the conviction that in patient and painstaking industry, thrift, and the serious character which is antirevolutionary and truly civic, the Germans are the most admirable people on the continent of Europe. The socialist movement in Germany is a rationalist movement in politics. There is no large revolutionary or anarchistic sentiment in Germany. The Germans expound the most daring theories but leave others to exploit them. They respect au-

thority, love institutions, and take a good slice of a century to hunt up a constitution for a constitutional government after they have decided to have one. The German influence in the United States, on the whole, is, and will continue to be, conservative.

A glance at the movement of emigrants through Bremen in the summer of 1890 is not without interest. A visit to several emigrant lodging houses and to the booking offices the day before the sailings reveals some hundreds of men, women, and children, with packs on their backs, the women especially being burdened with bundles often more bulky than themselves. Many of them wear wooden shoes. There is a great preponderance of brawn in both sexes, but the women give evidence of out-of-door exposure; the beauty and grace which one may see even in peasant women of the Latin race are wanting. There is less vivacity, but more endurance. These people are better content in poverty than our native American population is in comparative affluence. This portrait has its pathetic as well as its practical side. The genius for repose, which is quite wanting in American life, may be too pronounced in these German and Scandinavian contingents; but some infusion of contentment will not harm us.

There are parties of Austro-Hungarians in these groups of intending emigrants to the United States, more demonstrative and less desirable than the Germans. Their presence here illustrates the fascination which things forbidden possess. For two years Austria has taken very stringent measures to prevent emigration, but without effect. Having punished the police and gendarmes who were in collusion with emigrant agents in running population across the frontier, the Austrian Government may have fancied that her young men could be fenced in, but every week in the emigrant passenger lists of neighboring seaports there is a considerable sprinkling of uneasy and not especially desirable Austro-Hungarians, many of whom flock into the iron and coal districts of the United States. Legislation and decree against the freedom of personal movement in this age of itching palms develop device and mother wit; as in Italy so in Austria-Hungary.

Men walk 100 miles by devious and obscure routes and byways to escape the Austrian gendarmes and to find some road that leads to the United States. All roads no longer lead to Rome, but all highways and seaways lead to America. One of these Austrians remarks: "A friend of mine, an Austrian, went to Wisconsin a few years ago and prospered. He sent for his wife. The Austrian authorities forbade her departure; but she is here." Legislation against nature falls flat. To stop emigration or to reduce emigration European nations must remove the causes which are behind emigration—land monopoly, landlordism, and militantism.

The extent to which "prepaids" are pouring into Germany, Hungary, Poland, and Russia is unprecedented. The 10 per cent. of the Old World which has crossed to the New World in the last half century, im-

pelled by comradeship and pity, now seems bent on importing all their relatives, friends, and neighbors, and so entire villages and rural neighborhoods from the Old World are being translated to the New World, where they are reproduced in similar classes and groups, into which sometimes the English language filters very slowly. The enormous sums of money which the United States is sending annually to Europe by "prepaids" are the basis of the prosperity of great fleets of foreign steamships, not to speak of the strong financial currents created thereby in such cities as Bremen, Hamburg, Antwerp, Liverpool, Glasgow, and Cork.

It is not too much to say that if the countries of Europe were for one year deprived of the vast sums of money sent to Europe from the United States by immigrants and taken to Europe by the visiting and returning immigrant, every department of European enterprise would feel the shock. It would feel it more keenly if to this were added every one of the hundred thousand Americans who annually cross the Atlantic as sight-seers. It is probable that in the past two years from these two sources upwards of $500,000,000 have been taken from the New World to the Old.

When we are computing the balance of trade, this enormous purse should not be left out of the account. On the contrary the productive value to the United States of the three-quarters of a million largely of workers who in the same period have come to our shores, should not be overlooked, which according to some statisticians, would be in excess of $500,000,000. Our minister to Sweden estimates an able-bodied Swede to be worth $1,000 a year to us.

An agent prominently concerned with emigration from Bremen estimates that 33 per cent. of the emigrants of 1890 are induced to go to the United States by remittances from friends who have previously come to our country. The same gentleman says:

> Many millions of marks are annually sent into Germany, Austria, Hungary, and Poland from America. This money goes to support the old folks, as well as to forward new folks. These (to Europeans) prodigal remittances serve to intensify the preëxisting impression that the new Canaan flows with more milk and honey than the old Canaan. When a letter comes into a German village bearing one or two hundred marks to some old frau the event is celebrated over the village beer and pipe, and in the halo the New World is transfigured—the more when the girl working in the field and the man working in the shop compare their wages in marks with those American wages in dollars.

The manner in which whole villages of Europe are thus depopulated is shown by the movement through Bremen and Hamburg, the chief arteries of Russian emigration to the United States. The German colony of Rohrback near Odessa has been quite depopulated within two years, one thousand families from that district alone having gone from thence to Maryland and New Jersey. Recently one hundred families more have gone via Baltimore. These people are mainly Jews and many of them have been assisted by friends. The groups of Jewish em-

igrants from Russia form the saddest picture which the observer of emigration is called on to contemplate. Their faces are pathetic with the silent story of persecution, poverty, and hunger which the exodus of forty centuries ago could not well have exaggerated. Many of them are barefooted. I have seen them streaming through Stettin, coming from the dreary decks of lumber ships just arrived from Russia by which for a few pennies they are enabled to escape from Russia. Hebrew benevolent societies gather them in and by hook or by crook they find the free air of America.

I saw groups of these people at German ports just making ready for the States, young mothers with a nest-full of babies who were half nude, while the mother herself had very little clothes. To see these pitiful groups waiting for the salvation of the Lord in the promised land, turning the dog-eared leaves of the Hebrew Bible with undying faith in an ultimate Canaan, is to wonder on the one hand how much longer human brotherhood is to be a dream. Our country has always been justly proud that it is an asylum for the oppressed, the theater of unlimited catholicity and toleration; but our capacity to assimilate all those whom Europe has pinched, dwarfed, and persecuted, it is undeniable, is being severely taxed, though Americans would regretfully see the time when the law of self-preservation should even temporarily suspend the law of human brotherhood and silence the benedictions of universal asylum.

Regarding the emigration of anarchists and criminals through German ports, a representative of the German emigrant business says:

It is not believed that anarchists are going to the United States in such numbers as they did a few years ago. Two causes operate to diminish this movement—the retirement of Bismarck, which removes one of the leading stimulants to revolutionary as distinguished from evolutionary socialism, and, secondly, the heroic treatment which the Chicago anarchists received. Many socialists are among those emigrating, but these, as a rule, are peaceable disciples of Carl Marx or Lasalle.

The passenger agent of the North German Lloyds says:

Most of our emigrants have money left over after the purchase. Many have $100 to $200 each surplus. The North German Lloyd Company in 1889 forwarded 160,662 passengers to foreign countries. Of these, 48,972 were Germans, 27,760 were Austrians (or 10,419 Austrians and 17,341 Hungarians), 11,438 were Russians, 3,672 were Scandinavian; 722 were from other European countries. Of these 163,685 (including cabin passengers) were forwarded to the United States and 47,022 were dispatched to South America.

The emigrants to South America were recruited for the larger part from Spain, the rest from the Netherlands, Germany, Russia, and Scandinavia. Up to July 1, in 1890, this company has forwarded to the United States 56,987 passengers, 5,901 in excess of the corresponding period of 1889. To South America the emigration up to July 1 of this year has been rather slow for several reasons, but I expect it will soon commence again on a larger scale. This South American emigration depends on advances and encouragements which the South American countries may give emigrants, and on the degree of prosperity which last year's emigrants report. Very few of our emigrants are from cities, but they are mainly farmers or peasants. Our German emigration in 1889 was distributed from eighteen states prominently, and from

other small states in a degree, and Bavaria sent us the largest number, 6,163; next came Posen, with 5,946; West Prussia sent 5,688; Hanover, 5,561; Pomerania, 4,618; Würtemburg, 3,271; Nassau, 2,149; Brandenburg, 2,025; Hessia, 1,328; Baden, 1,248; Westphalia, 1,206; Saxony (Kingdom), 1,194; Oldenburg, 1,107; Schleswig, 1,039; East Prussia, 1,079.

The past year no criminals or paupers have been detected in our steerage list; nor do we believe we have forwarded any Mormons to the United States. We have never found a case of leprosy. We had one case of small-pox in 1889, and have occasional cases of scarlet fever, measles, and diphtheria. Whenever an emigrant is sick or is looking suspicious, the boarding-house keepers, who are under our control, are obliged to report at once, and we send the physician to examine whether or not it is a case of contagious disease. If it prove to be such the patient is brought to the city hospital, where he or she must stay at our expense until the danger is passed.

On the morning of the departure of the steamer all the emigrants, before being allowed to enter the depot to pass to the ship, must be inspected by the ship's doctor, one by one, and all suspicious cases are strictly shut out. I do not know what nationalities tend to increase and what to decrease in the steerage list; there is a good deal of variation from month to month. I think that our emigrants average to take out $50 surplus, but that is simply an estimate.

For four years there has been almost no variation in steerage rates, which are governed by competition only. The lowest rate for the present year now in operation is $16, but this rate refers only to emigrants from Scandinavian countries, via Bremen to New York, due to competition of British lines, which has kept the rates very low. My impression is that 90 per cent. of the emigration via Bremen to the United States, and perhaps even more, is caused by letters from friends in the United States, while the proportion of prepaid tickets this year rises to 30 or 40 per cent. of the whole. I know of a few cases of children going over to join their parents, and wives to join their husbands, whose passage was paid by assistance from this side, but I know of no organization for any such special purpose. We are not aware of the forwarding of any contract labor or of any attempt to do so.

Last year 20,102 steerage passengers came over to Germany from the United States by our ships. Most of these return to the United States within a year. Of course these are better off than most of the other emigrants. Those who come back to Germany with the purpose of staying, as a rule, have not much more money than just to reach their former home.

The total emigration from Russia via German ports in 1889 was 36,629, of whom 11,438 sailed via Bremen, 24,875 via Hamburg, and 316 via Stettin. The Russian emigrants via Bremen were to a great extent German farmers who formerly had emigrated to south Russia and who generally are well-to-do people, or Polish and Lithuanian farm laborers, in smaller part Russian and Polish Jews. These Jews are the poorest class of emigrants in every respect. It is for the reason that they can hardly pay their fare that the greatest number of them go by routes cheaper than the Bremen route. Most of the Scandinavian emigrants go via England, but the few thousands who come by the way of Bremen are people of good appearance, but sometimes apt to take to drink, and generally without money after paying their fare.

The American consul at Bremen states:

The emigration to the United States from Bremen in recent years has been as follows:

1884	102,429	1887	96,944
1885	83,072	1888	92,777
1886	74,232	1889	97,873

showing considerable regularity. Perhaps 10 per cent. of this emigration comes from cities, and of this at least 5 per cent. is very undesirable. German emigrants,

as a rule, are desirable, industrious, and will make good citizens. I do not think that educated socialists are going to the United States in large numbers. Perhaps German emigrants take $50 to $100 with them to the United States. The greatest encouragement to emigration is that offered by prepaid tickets, which, I think, are about 50 per cent. of the whole. The Mormons are doing no work in Germany, as the police forbid them, but in Sweden and Denmark I think they are operating.

I think there is some danger of contagious disease getting to the United States from this part of Europe, especially from the lower strata of Eastern natives, that gather in German ports to sail for America. A more thorough health inspection in my judgment is called for. From the transient crowd of emigrants from all over the world that congregate here on the days of sailing, I judge the Bohemians, Hungarians, Poles, Italians, and poor Russian Jews are not so desirable. Few Germans will become a public charge, because few sail who have not work prepared for them or friends who will assist them in the United States. Many young men from all classes and conditions in life emigrate hence to escape military service. To better their condition in life is the chief motive, however, of all emigration. The prepaid contingent leave Bremen with tickets to their ultimate destination by rail from New York; they know how to get there and just what to do on reaching New York; but only a small number of new emigrants can understand or speak English.

The German Government is doing all it possibly can to stay emigration to the United States. If it could, it would prohibit it altogether; but the results, as shown by statistics, are quite impotent. No German newspaper can receive or accept advertisements of a nature to induce or encourage emigration, and no posters or circulars of any kind whatsoever in relation to emigration are permitted by the authorities in public places. There is even an attempt to suppress the circulation of such matter through the German mails. The Government refuses to grant licenses to emigrant agents to do business, sell tickets, etc., and soliciting emigration is strictly prohibited.

The following is a statement of the purely steerage emigration from Germany in recent years:

German emigration via—

Bremen	48,972
Hamburg	22,963
Other German ports	2,166
French and Dutch ports	16,231
Total	90,332

Against the following from 1881 to 1888:

1888	103,951	1884	149,065
1887	104,787	1883	173,616
1886	83,225	1882	203,585
1885	110,119	1881	220,902

In 1889 have emigrated to the United States, 84,497, against 99,800, 1888. To Brazil, 2,412; to Africa, 422; to Asia, 262, and Australia, 496.

One of the most striking facts about the present movements of population is the vast development of internationalism of a practical kind, the large numbers, especially of Germans and Italians, who gravitate between the Old World and the New, finally having done their social and economic evangelism, settling down as well-established Americans. The education in politics which is thus spread throughout Europe is great. Historians are fond of dwelling on the momentous consequences of the Crusades, but they have not yet the "data to weigh the far-reaching influence of the economic crusade generated in the nineteenth cen-

tury by cheap transit, steam, quick mails, the bill of exchange, and the newspaper. The amazing progress of democracy in Europe is as much the result of emigration to the United States as it is its cause, and no political foresight or economic insight is at all adequate to intelligently predict the changes in political, economic and social life which the electric disciplines of population are liable to generate in the twentieth century, in whose dawn most of our contemporaries, both in politics and in industry, are soon to be living. When one line of steamships from a single port in one year delivers from Europe to other continents people in numbers ample to create a large city, or half as many people as now dwell in San Francisco, we begin to perceive that amazing as were the consequences of the Aryan movement on foot, in the dawn of history, the European movement by steam in the nineteenth century is a colossus in comparison. What should we say if in a single year over 50,000 Americans should sail from Boston to find a home in Cape Town or New Sydney?

That it begins to be a question for statesmen as well as for philosophers, for political economy as well as for builders of the census, for legislative halls as well as for steamship exchequers is not surprising.

And now a more particular glance at types is of practical interest. A new type is pointed out in a group of emigrants at Bremen—lieutenants, depleted barons and counts, officers who have fought duels and found other homes more desirable, bankrupts, even bankers who have collapsed in the remarkable fluctuations which Germany has witnessed in her recent financial history.

Representatives of these classes are constantly going to the United States in quest of repair for dislocated fortunes—these generally go first or second cabin. The number of actual emigrants who do not appear in the records of Castle Garden is large and tends to grow larger. One modest second-cabin passenger remarked: "All the best people now go second cabin." The second cabin doubtless is becoming a more important factor of emigration every year. Germany has the largest unavailable surplus of thoroughly educated men of any country in the world, and only the United States surpasses Germany in the number of those who might be said to be "passably well" educated. The German emigration is as literate as the emigration of Italy is illiterate.

I observed in the second-cabin list of a ship sailing for the United States from Bremen, an impoverished count who spoke several languages; was a graduate of the university of Leipsic. The paternal estate was not ample to keep up the social dignity of a number of sons and daughters, and social conditions are such in Germany that an aristocracy without land or money finds a more congenial clime in the United States. The efforts of Germany to purchase dismembered estates and create a small farming class are in the right direction, but time will be required to make the results tell in the successful colonization of the provinces, for emigration yet pours *out of the provinces* where these colonizing efforts are most pronounced.

One of the emigrant lodging-houses in Bremen furnishes the following types: Here are 200 emigrants who will sail on to-morrow (July, 1890); perhaps 50 of them are emigrating for the second time, having returned "home" to Europe to break the last links and settle their affairs, take their families, and finally cast in their lots with Americans. It is evident that we count not a few European emigrants at Castle Garden twice and a considerable number thrice. Says one of the observers of the emigrant movement to the writer:

> There are 40 young fellows in that group yonder whom I saw returning from the United States last fall. They are now about returning together to the United States. I can not prove that they are contract laborers, but I believe they are. They form an illustration of a good many emigrants. They have a leader; if the boarding-house gets that leader, he gets the whole party—they follow him as the sheep follow their leader. These parties formerly went to Holland to make brick by contract; now they do better by going to the United States. Do you see that woman who goes along with them with that huge pack on her back? She does the drudgery for the workmen, cooks for them and carries their rags. Every group of ten of these contract workers has an old woman to do their cooking.
>
> Who are they? They are generally Poles, generally young, generally ignorant. They are warranted work in the States at better wages than they used to get in Holland. They scrape together considerable money in the States and return to Poland each autumn to stay until they are again wanted in the ensuing spring in the United States. They travel from Poland to Bremen in fourth-class cars, like cattle and at live-stock rates. They can get rich on low wages, live on pork and stale bread, and are killing competitors of unskilled American labor.

Perhaps the most pitiable lot in the emigrant groups which I am describing is a party of Russian Jews starved out of Russia, going to the United States to join the congested ranks of middlemen. They are almost revolting, mainly pedlers of the smallest scale. Nobody wants them even in the poorest emigrant lodging houses. The more one observes this movement the more he is inclined to say that the place to stop it is not at Castle Garden but in Russia.

I learn that in England students of this subject are now urging that the question be made a subject of diplomatic attention, for England is suffering from pauper immigration more notably according to its population than ourselves.

A comparison of the personnel of the various natural groups in Bremen emigrant lodging houses shows at a glance the superiority of the Germans and Scandinavians. These Germans have an average of $50 in their pockets, besides their tickets to the American destination, some of them as far as Missouri and Dakota, but the Jews and Poles are practically penniless. Had not many of them friends in the United States failure to obtain work on landing would force them into our almshouses or into beggary.

> And yet (says an agent) some of these ragged fellows have plenty of money. I have known one of the most abject of the lot to beg his fare to America; pretend that he had not money enough to within 10 marks to buy a ticket, who, being searched, was found to have lots of money. I asked one fellow, who solemnly swore he hadn't another kreutzer, to submit to examination. He did so reluctantly, when he finally

showed up quite a purse of florins. I said to him, "Why did you lie to me?" He coolly replied, "I didn't lie; I hadn't a single kreutzer."

"Formerly there was medical examination of emigrants by a physician in the service of our Government and under the control of the United States consul, but for economy's sake this examination was abandoned. I think that it would be well to re-establish such United States inspection on this side, not only for medical reasons, but because it would give the United States consuls in Europe some practical connection with the emigrant movement and many clues to what is going on that at present our representatives in Europe have no opportunity of securing. Formerly there were two medical inspections by the United States doctor, one at the depot in Bremen and one at the ship, besides the inspection of the ship's doctor. Formerly the United States inspection used to throw out from three to six intending emigrants for bad or threatening appearance of disease, giving the benefit of the doubts to the majority. Since the abandonment of United States inspection in Europe, quarantine has been more frequent.

The number of children going to the United States this year through Bremen and Hamburg is larger rather than smaller than usual. I observed one family of fifteen children and several of ten children. The Germans have boxes, trunks, and chests nailed up, full of effects, but the Poles and Bohemians (especially the suspected contract groups) have only what they wear. In a lot of twenty-four the only baggage I could discover was twenty-four pipes. If there is any baggage in the Bohemian ranks their *vivandiere* carries it. The young men never give the pack-bearer a lift, but the poor woman with bent back fetches up the rear, a striking object lesson of the degradation of her sex in eastern Europe.

One of the emigrant middlemen states:

The English Government has secret detectives here at Bremen, under an old understanding with Bismarck, looking out especially for anarchists. But it is European paupers whom they have need more to look out for, if they only knew it. It's absolutely dreadful the way these poor wretches are dumped into England by sailing vessels, steamers, and all sorts of ships. It's come to be an accepted idea on the Continent that if there's anybody who hates himself, anybody whom everybody wants to get rid of, quietly help him over to England. You get a lot of these fellows in America, but England has more of a grievance than the United States.

My observations in England lead me to believe that there is probably much truth in these statements, but I am also inclined to believe that much of this worthless emigration which floats into England uses England as a way-station to a yet further pilgrimage, which ends in New York, Philadelphia, Baltimore, or Boston.

About the offices in Bremen where emigrant tickets are sold are some interesting subjects. The Polish emigrants who are going over for the first time do not understand where they are going, except to America, whether North or South America. They do not know, because it is all "America," but the Germans have maps in their pockets and point out just the place of their several destinations.

In the spring of 1890 agents sent out to Austria and got Austrian high officials to help them drum up recruits in plain violation of Austrian law. A great increase in Austro-Hungarian emigration ensued, but the movement was discovered, the officials sent to prison, and the emigrants from Hungary and Austria now jump the fence in diminished but in yet considerable numbers. But 5,000 to 6,000 Austro-Hunga-

rians were induced to emigrate by Austrian officials receiving a commission of so much per head from Bremen and Hamburg middlemen. The influence of the almighty mark in inducing emigration is enormous. If there is the almighty dollar in America there is the almighty quarter dollar in Europe.

I have already referred to the obstructions placed in the way of emigration by the German Government. The German Lloyd's have great difficulty in getting an emigrant agent for the sale of tickets to replace one who dies. The government dislikes to license a successor, and one is secured only by giving heavy bonds. Germany wants to keep all who have money enough to emigrate. The frontier is well guarded, but refugees get past the line and pass into the States. One sees some pardoned criminals. A lawyer who was sentenced to imprisonment for swindling was pardoned and sailed hence for the United States to start anew. Such persons are advised to leave their country for the joint good of country and self.

An American resident in Bremen states:

I know of one case where two ex-convicts were assisted to leave Germany for the United States by a benevolent society. There are in every large German city societies to help ex-criminals to get a new start in the world. The United States consul at Bremen detected one case where two convicts had a new outfit and tickets for New York furnished by a benevolent society. These men were returned to Germany, but probably they have since gone to New York by some other line. They are birds of prey; you may see them in new suits and new outfits, hand-bag, etc., and generally they are tramps or ex-criminals who are being helped out of Europe, not by the government, but by so-called benevolent societies, whose object in part, I fear, is to get rid of undesirable population more than to bless all mankind.

If a medical inspection were reëstablished, the United States consul could get a chance to look at other aspects of emigration as well as at the sanitary side of it. To be sure, our consuls would have to make long days, at times, but they ought to have enlarged jurisdiction over emigration. The place to regulate the emigrant is before he is an emigrant—certainly not when he is an immigrant. A few examples at European docks would be very telling; for many objectionable persons are sent to the States by communities and cities as well as by societies.

I have known rates to the United States as low as $7.50 in times of sharp competition. In Würtemburg and other centers for emigrants you may often buy tickets for America cheaper than in Bremen.

The German emigrants generally leave here in clothing which they have made themselves, comfortable and clean. Before they leave their neighborhoods in the German country they weave their own cloth; the wandering tailor comes and cuts the garments in their houses; the boot maker comes and boots them for a year; so they take a year's stock with them—paying the tailor and the boot-maker each about 37 cents a day. The Germans are famous for keeping a lot of linen and wearing apparel in their trunks. The character of a German servant girl is measured by her stores of linen and stockings. If she has thirty pairs of stockings, she is a good girl, and for a year before she sails for America her knitting work and her loom are busy. Domestic weaving of linen in winter and in wet weather, when outdoor farm work is impracticable, prevents the possibility of any idleness in German domestic life.

The same authority, speaking of Jewish emigration, remarks:

I think the prejudice against the Jews is industrial and secular rather than religious. Their habitual disregard of codes of European morals creates antipathy. Each

race has its own standards, and an industrial population lays greater stress on integrity than does a purely agricultural or ecclesastical people. The Jews have their virtues; many Jews in Germany are our best citizens, public spirited and productive, but those who sell their birth-right for a mess of pottage are in no respect desirable.

Here are some types from the emigrant list of one of the North German Lloyd's ships as studied in a Bremen emigrant lodging-house. There are several Hungarians who have skedaddled from military service. From this company some were abstracted by the gendarmes on the Austrian border, but these escaped and tell rich stories of their adventures in evading the police. Of eight hundred steerage passengers on to-morrow's ship two hundred and fifty are Hungarians, one hundred are Norwegians, and the remainder Germans. You can tell the nations of eastern Europe by two senses. The cleanliness of the Germans qualifies them for distinction solely by the sense of sight.

One of the Hungarians says:

I go to Cleveland to work in copper works; my brother is there; he makes four times the wages he could in Hungary. I was a farm worker in Hungary. I shall send for my family as soon as I get money enough to pay their passage.

Another says:

I go to join my son who is in Pittsburgh where he makes $1.50 per day—four times the wages in Hungary.

A barefooted girl of perhaps twenty years, her head picturesquely draped in a bright kerchief, is going to join her father in Wisconsin.

One farmer's wife (Hungarian) with five children and a servant is going to join her husband in Cleveland, Ohio, where he is earning $3 a day. She is a cleanly Austrian housewife, speaks German, and has the physique of an Amazon.

A Hungarian girl, who has earned $7 a year in the family of a Hungarian nobleman, because she hears that in the United States she can earn in two weeks as much as she has got in Hungary in a whole year. She has with her another girl, her friend. She wears thick cowhide boots of tremendous kicking capacity, short skirts, a kerchief-covered head, and a profound faith in the New World characterizes her face, which is comely and nut brown. Yet another, another Hungarian girl will join her father in Minneapolis and do housework. Another, a man, is making his second pilgrimage to the States; has been a brick-maker in New Jersey at $2 per day, vice 40 cents per day in Hungary.

A young German farmer, smoking a pipe of enormous stem, will join his brother in Clinton, N. Y., and will stay, if he likes. Most of these cases are assisted by friends in the United States. They average to have about $10 in their pockets.

A German chair maker will join his brother in San Francisco and shows a ticket from Bremen to that city prepaid.

On the sidewalk is another group of Hungarians about to sail for America. Some of the adults are barefooted. One has rags on his feet and is vainly trying to get an old boot over the rags.

A jocky-looking fellow, with a rakish air, is probably an adventurer from a Hungarian city. He has an impudent and assertive presence, which is in striking contrast with that of the rustics about him.

But out of a hundred or more I find but few who have no trade or who are at sea respecting their destination. "Friends in America" is the inducement and the source of definite knowledge and purpose of a very large contingent of all emigration to the United States.

A visit to an emigrant lodging house which is the headquarters largely of Swedes, who are cared for at the expense of the ship until to-morrow's sailing, reveals an apparently very desirable class of emigrants. One, a carpenter, a bright fellow, is the only English-speaking man I have found out of several hundred of emigrants encountered at Bremen. He has been in the United States several years, and says: "I voted for Harison for President"—the first politics I have ever discovered in a European emigrant. His family is in New York and he has been over to Sweden on a short visit. He gets $3.50 day wages in New York, but 50 cents a day he used to get in Sweden. Another is a sailor, also a Swede, going to San Francisco, a fine-looking fellow. Another is a farmer, going to California. A fourth has a ticket for Wisconsin where he will work in a mill.

There is also a company of Finns, a hardy, big-bodied lot, going West on assisted passages or prepaids. One says in broken English:

> I'se no friend in de United States but de dollar and I find him *dere*.

One Finnish girl was frightened by the interpreter's questions, fearing lest they indicated she was to be sent back to her home, burst into tears, but was reassured on learning that the questions had no such significance, and kissed his hand in gratitude.

The scenes at the embarkation of steerage passengers in Bremen, Hamburg, and other foreign ports are both ludicrous and pathetic, according to the point of view of the observer. One cabin passenger (a German) looking at the motley and ragged crowd literally taking up their beds and walking in quest of new homes in the sunset land, remarked:

> Thirty years ago I set sail in an emigrant ship from Hamburg for New York. When I landed I was without a penny. Since then I have lived in the United States and have prospered.

I was informed by others that he is a millionaire.

> Notwithstanding the 30 per cent. protective duty on farm products, the German farmer is crippled by scarcity of workers [says a German farmer], and there is talk of importing coolies. We now get a few at harvest from the cities and some from Silesia. The great trouble is low wages. Germany is pressing colonists into Africa and importing Swedish women to help the German farmer.

Two hours from Bremen by rail is Hamburg, the most important and populous seaport in Germany, and of particular importance in these studies of emigration. As many as two thousand emigrants a week leave Hamburg for foreign ports during the spring months, and of classes more varied, if possible, than from Bremen; certainly a larger contingent of Russians and Hungarians and other peoples of the north and east of Europe. A movement of Roumanians has begun and efforts are being made to bring over a "bunch" of six hundred from one Roumanian district to settle in the United States. There is one important feature of the emigration from Hamburg—the Mennonite movement from Russia. These people are wealthy farmers of a high class of intelligence, and several hundreds have sailed for the United States the present year. They generally choose the express steamers of the Hamburg-American line, and avoid the steerage in many cases.

One party of two hundred of these people who sailed last spring (1890) bad $50,000 on deposit in Hamburg, which they drew out before sailing for America. These people are very religious and moral, and come from the Odessa district in Russia. The low rates of interest and minimum rates of profit in old countries are very important factors in the increase of capital in new and prosperous countries like ours; but it would seem that the movement of emigration was never before so manifestly accompanied by a stream of gold. The sums which we spend in Europe on travel, pleasure, and education, are restored to us with compound interest by capital seeking investment and labor seeking a more adequate reward. The stream of emigration is now bringing to us all classes of Europeans, the rich, the titled, the upper middle class, the lower middle class, and the half-starved peasantry.

An American, long resident in Hamburg and a close observer of social and industrial life as well as of the movements of population, speaks as follows:

> In some years nearly half of the immense emigration through this port has been women and children. Of the 23,000 who were classed in one year's emigration list as "without occupation," a very large majority were women and children.

The large proportion of emigrants usually, however, are able-bodied men, and we should reflect that we get them at the most productive period of their lives. It probably costs a thousand dollars in the United States to get a child into useful and educated manhood, and probably half as much in Europe, so that a country which is parting with its young and middle-aged men and women is losing a vast labor power, and the country which takes this power must necessarily increase in wealth and enterprise in a phenomenal degree. On the contrary, we are expending no small part of this gain in rearing and educating the children of emigrants whose families are more numerous than our own. The industrial development of the United States amazes Europe, but Europe has greatly contributed to this result under the leadership of the native American population.

Germans possess the old roving spirit of their Teutonic ancestors, and this spirit is punctuated by the dislike of the army service. All able-bodied youth between seventeen and twenty-five are subjects of military service, and can not emigrate unless they can produce testimony that they are not emigrating to escape military service. There are secret societies to promote emigration as well as charitable societies to help unfortunates.

It is a curious fact that overpopulation relates less to absolute density than to the opportunity of livelihood. The most densely populated parts of Europe send the fewest emigrants. This is true not only of cities but of countries like Belgium and sections of all countries. For example, Pomerania has large holdings of land and landlordism prevents small farming; the movement of emigration thence obviously should be large, as in fact it is. Throughout the world it is true that the average hardship of life in cities is less than in the country. After a time overpopulation in cities by its own distress will cure or tend to remedy this evil, and then we shall probably begin to see improvement in the condition and profit of agriculture. The conditions which promote emigration accordingly are social, political, and economic. In Bavaria small farms prevail, and there is less emigration from that state than from most other states of Germany.

A German-American in Hamburg speaks as follows:

Many criminals and socialists have gone to the United States from Germany in recent years, because they are not so thoroughly hounded there, while the American laws are less impertinent than the German. Our German Social Democrats have so much freedom in the United States that they don't know what to do with it. Religious toleration in Germany is boundless because, for one reason, religion sits very easily on the German conscience; hence, the religious bias, which formerly was a great factor in the transmigrations of population, has very little active force in the modern equation by which equilibrium is maintained in the matter of mouths and bread.

As to contagious diseases my idea is that we ought to prohibit the exportation of rags unaccompanied by a consular certificate of disinfection prior to shipment. Infection also is sporadic chiefly through old clothes tied up in infected districts and opened up on ship or on shore.

It is a fact, by the way, which may not be generally understood, that German anarchists as a rule are persons of one of three skilled trades—printers, tailors, and cigar makers. In fact the presumption is if you see a German printer, tailor, or cigar maker going to the United States that he is a pronounced socialist, often a decided anarchist. I have often noticed that the anarchists are men who belong to the *sitting-down trades*.

I presume it is not generally known, but I have reason to believe that the police of Hamburg have a standing contract with ships regularly leaving for English ports to ship German paupers, tramps, and other scum of German and European civilization to England. The great question of modern government is, "What shall we do with the criminal and pauper classes?" You see how Hamburg solves the riddle; but I often wonder at the patience which England displays over this business.

In fact, the doctrine of *laissez faire* is so ingrained in the English individual as well as social and political life that it is with the usual

extreme reluctance that English law touches even the right of a tramp or the freedom of action of a pauper.

The Hamburg police (continues the gentleman above quoted) don't give tramps and paupers from the interior or from other countries of eastern Europe, the slightest show in Hamburg. They don't give them twenty-four hours to leave town as some police judges do in the United States, but they lock them up on board ship bound for England and in a few hours they are breathing the smoke of London, the fog of Hull, or the Scotch mist of Leith or Glasgow. How many of them in course of time reach New York, Boston, Philadelphia, and Baltimore, no one can tell; but my opinion is that our laws, public sentiment, and the abject poverty of the classes concerned prevent any considerable emigration of this class and the British conscience and sense of international courtesy prevent any large deportation of paupers from England and Scotland into the United States; yet the impression is that our greatest danger of pauper emigration is not from Italy, Germany, or any other country of continental Europe so much as from the United Kingdom. Even the pauper emigration of Russia afflicts England more than the United States, as any one may see in the Jewish and other quarters of London, Manchester, and other large cities of England and Scotland both those on the seaboard and those in the interior.

Returning to Hamburg, let me call your attention to the fact that this city has more shipping in the foreign trade than is owned by all the United States, and in the past nine months I have never seen a ship bearing the American flag in this harbor. Even the coffee which you pour out of your coffeepots in the States passes through this port before it goes to you. The South American and East and West African trade of Hamburg is enormous and by subsidies it is being constantly increased.

The bonded warehouses of Hamburg are of enormous capacity. It is obvious that the United States, in attending to internal improvement have forgotten that the world's carrying trade is next in importance to its commerce and that the people who are swarming from Germany and Great Britain represent not only agriculture and manufactures, but the capacity also for commerce and the carriage of the products which create commerce. English is spoken everywhere in Hamburg; the children in the public schools are taught English.

There is enormous advantage in the race for trade, other things being equal, in favor of that race which can speak, read, and write in the two foremost languages employed by modern commerce. I see that in the United States you insist that English shall be the only language of the common school. In so far as you insist that your Germans shall learn English and be taught in English, in so far as you resist all efforts to denationalize English speech, you are correct; but a crusade against instruction in other languages is a mistake. I claim that if every man, woman, and child in the United States could speak and write three languages, or even two languages, our grip of the world's market would be irresistible and our utilization of the emigrant of much greater value to us.

As to the immediate emigration from Germany, let me call your attention to certain aspects of emigration from Schleswig Holstein. The movement from that province is more largely of young perso ns who are sent out to America before they arrive at the age of military duty. Many of these are young fellows who return to their native villages in a few years well dressed, more or less flippant and critical of German life. They boast of their successes and tell their old friends what big fools they are to stay in Schleswig Holstein and starve. The German authorities are watchful and recently they have sent these youths cavorting out of the country. These people apply to the consul with their passports for redress, but he generally tells them that their departure is naturally expedited by their own want of tact. American citizenship can't cure an ass.

In 1846 nearly all the emigration from Germany was moved to the United States in sailing vessels but in 1888 only eleven persons out of about

100,000 sailed from Hamburg under canvas. Of 88,000 emigrants from Hamburg in a single year only 1½ per cent. were from Hamburg; 21 per cent were from Russia, 29 per cent. from Germany, and 71 per cent. from other parts of Europe. Of the total classified emigration of Germany 65 per cent. of the males are unmarried, 33 per cent. of the females are single and there has been 65 per cent. more males than females.

Many efforts are made in Europe by agents of western railroads and of other owners of large tracts of land in the United States to induce emigration. The European steamship lines receive many requests from such sources to stimulate, invite, or direct emigration. The only way in which results are achieved in this direction is by putting a literature of the land in various languages into the steerage of steamers, and by putting special agents into countries where such work is permitted. But far less of this work is done than might be supposed. No doubt much might be done intelligently to inform, rather to advise, emigrants if a disinterested literature of American idle lands both in the West and in the East were distributed in the steerage of all emigrant steamships in various languages, for in the leisure of voyages of a week or ten days the large contingent of emigrants who read could be informed, while those who do not read would orally obtain valuable practical information. The Swedish settlement in Maine and the Scandinavian movement to Vermont are illustrations of how much can be done by informing emigration.

The steamship companies in Europe are very much afraid of the conservative reactions in the United States affecting emigration. Among many Germans there prevails the impression that "the States" are trying to reduce emigration, irrespective of its character, so far as the legislation of Congress is concerned, being blind to the fact that Americans are anxious to see the emigrant who can be turned into a good citizen and to suppress the pauper, convict, and undesirable classes only—those especially who can not safely be assimilated. Active prejudice against the foreigner is only sporadic in our country as a political or social fact. The Know-Nothing-party idea will always be a feeble and intermittent craze because most of us are foreigners or a few removes from foreigners. Reckoning as native Americans only those who are descendants of 1789, as our author does, we perceive that few of us are really orthodox Americans, according to the standard of some purists.

We are the country uniquely of welcome to the races, and because such is the fact, we have moved forward industrially, socially and politically. On the continent of Europe, on the contrary, the foreigner is the victim of an active and belittling prejudice. One who has undertaken a residence in a German city, will especially have occasion to observe the force of this prejudice, its annoyances and its costs. The law is against him and a gospel for him has not yet appeared. If he sends his children to a private school in Germany, if he becomes the

subject of taxation, he will soon perceive that the odds are against him because he is a foreigner. One who has himself been a foreigner in Europe will generally return to his native clime in America, more than ever attached to the breadth, height and length of the general American hospitality to emigrants.

Not long since a naturalized American, formerly a German citizen, came into the American consulate at Hamburg with a grievance. He had been in the United States for some years; had bought a farm in our country near a future city which grew out toward him and made him rich. He came to Hamburg and got the necessary permission of the city senate to buy a house in Hamburg; for a citizen of another country can not own real estate in Germany without official permission. Later on the man bought another house in Hamburg. His wife and children decided they did not want to return to the United States, and, accordingly, the man bought a third house in Hamburg, also by permission, for his own residence. The family thus settled down into German life and residence.

The man's passport having expired, he applied at the American consulate for another. The consul refused to issue another passport in his case, because he had so long been awayfrom the United States, and because he had for so long been practically a citizen of Germany, in his own German house. He then surrendered his citizenship in the United States and applied to the German Government to be reinstated as a German citizen; but the German Government after much delay, finally decided not to reinstate him, having in view, perhaps, the influence of such a precedent in encouraging an easy sense of the evolution and devolution of German citizenship. But a foreigner is not allowed to live in Germany on such a status.

The dilemma of this man was singular. He had sold his house in the United States; he had forsaken his citizenship in the Western World after abandoning his German birthright, and although he owned three houses in Hamburg, he was a man without a home, a man without a country. There are many similar cases, especially in Schleswig Holstein, formerly Danish.

Germany is very jealous of all influences which affect the national spirit, and emigrants who return and brag that they "Don't have to wear the Emperor's uniform," or who in other ways tend to sow seeds of disaffection or discontent, already plenty enough in the Empire, very speedily feel the heavy hand of "paternal government."

Among the many fiscal results of the German emigration movement to the United States is one not hitherto adverted to. As emigration becomes an historic fact with generations behind it, estates of Germans in the United States who at death left no heirs in our country, multiply. In the past summer $80,000 in hard money was sent over to Hamburg from one estate of a German, deceased, in the United States. Millions of dollars are annually coming to Germany in this manner; but perhaps

25 per cent. of as much returns to the United States from Germany through German estates divided among heirs, portions, or all of whom are our adopted citizens. As the ties between our country and Europe multiply, it is evident that the complexity of the question of emigration increases not only on its social and political but also on its economic sides.

Following are the replies of the director of the Hamburg-American steam-ship lines to certain inquiries propounded for the purposes of these studies:

1. The total emigration by our line in 1889 was 52,388 souls.

2. The total of emigrants forwarded by us to the United States of North America in 1889 was 47,160 souls.

3. We do not entertain a service to South America. The number of passengers forwarded by our Mexican West Indian line in 1889 was 3,708 souls.

4. We forwarded to the United States from January till June, 1890, 26,994 souls, against 20,143 souls in 1889.

5. The emigration during all past months in this year shows an increase in March and April of 33⅓ per cent; in May of 25 per cent.

6. The prospects for the rest of the year, let us assume for pretty certain, are that the number of passengers forwarded in the same period last year will be arrived at again.

7. The majority of our emigrants consists of country people. The emigration of laborers and from cities is not so great as generally is assumed, for even among those small artisans coming from the country there are many to whom farming is familiar.

8. As far as possible we estimate the number of real farmers at 40 to 45 per cent.; that of artisans and laborers at 25 to 30 per cent.; whilst the rest may consist of tradesmen, teachers, etc.

9. Our passengers come for the most part from North Germany. In Prussia, mainly the inhabitants of Schleswig-Holstein, Posen, Pommern, Brandenburg, etc., prefer the Hamburg port for embarkation.

10. We have had in some cases cause to refuse passengers applying to our agents for fear of their getting returned as paupers. In spite of our having repeatedly explained in the instructions for our agents and in special circulars the respective regulations of the American law, it is not to be avoided that now and then an inexperienced agent attempts to engage a person unable to gain his living. We have found out at the embarkation in the last two years in two or three cases such individuals, and caused their return home to their former place of residence. In most cases, however, the agents refuse the engagement of such persons because the whole responsibility is laid on them by us. The emigrants are examined here before their embarkation by a physician, and those who are suspected to be, through inner or external diseases, contagious or otherwise, or troublesome to their fellow-passengers, are excluded from embarkation by the authorities.

11. We forward from Havre, at which port some of our steamers call on their passage to New York, frequently, Italian emigrants, but in small numbers. The emigration from Austria, via Hamburg, has decreased considerably in the last year.

12. The amount after paying passage taken by the passengers with them to America varies very much, but as a rule it is certain that on an average the emigrants from the country most often take large sums with them. This is to be attributed to the circumstance that these people, as a rule, have sold their estate, cattle, land, etc., inherited or acquired by themselves, for cash to invest it in establishing a new home. We have forwarded numerous families in the course of the last year who took with them 10,000, 20,000, nay even 40,000 and 60,000 marks in cash. The average amount per head of the country people we estimated at 300 to 400 marks; artisans and laborers,

who can dispose only of savings gained by their own handiwork, and who do not require a larger capital for their establishing, take of course less with them, but even their money in cash may on arrival at New York amount on an average to 100 to 200 marks.

13. The steerage fares have been settled since several years by an agreement of all steamer lines from Europe to North America, and there does not exist any more a difference since about five years in the summer and winter rates.

14. The Mormons in the majority used to take their way via English ports per "Guion Line." As far as we know there is scarcely a larger emigration to be expected in the present year. They never went by our line.

15. About one-third of our passengers undertake the voyage on the ground of tickets bought in America respectively with money sent from there (so-called pre-paid certificates).

16. Cases of assisted emigration we rarely have had to deal with, and generally it was the question to make it possible for women with children to get to their husband or father residing in America, who, though mostly having a good existence, had hitherto no opportunity to save the whole fare required for the passage of his relations.

17. Up to now we have had no opportunty to find out contract laborers; we would have excluded them at once from exportation.

18. Passengers of the criminal class have, to our knowledge, not been forwarded hitherto by our line, and also the control exercised by English detectives here since several years have had no results as far as we know.

19. The number of so-called returns may amount to about 6 to 7 per cent.

20. The number of steerage passengers forwarded by our steamers from New York to Europe amounts to about 13,000 per annum, and these passengers are on an average pretty well provided with money. We think, however, that irrespective of the difference in the number of passengers, the passengers to America take generally more money with them than those returning bring in proportion with them. This may be accounted for by the fact that those passengers visiting Europe are for the most part laborers, artisans, farmers, etc., and take with them only the savings gained by their handiwork, whilst those farmers gone abroad with a larger capital have invested their money in farms which they acquired as their permanent property.

21. The importance of the Russian emigration is often most decidedly underrated. An important, and for the United States most valuable, element is the farmers coming from the German-Russian colonies, so-called colonists, for the greater part Mennonites, who are excellent cultivators, and almost without exception in possession of considerable capital. These people, who have done very much towards the cultivation of many Russian, otherwise barren, tracts of land, leave their native country only by constraint of political and social, for them unbearable, circumstances. The Russian Jews are regarded throughout as traders, which, however, is a wrong conception. On the contrary, they are mostly small artisans, who devote themselves to the retail business in America only for the reason because at first they are not familiar with the peculiarities of American work and do not feel themselves equal to satisfy the requirements there, and also because their language is difficult to be understood renders their existence difficult at first.

22. We participate in the Scandinavian emigration to a larger extent only in Denmark, from whence we forward about 3,000 to 4,000 per year, mostly male, passengers to North America. These people go mostly to relations or friends already resident in America, and belong almost exclusively to the class of farmers who are sober and clever in gaining their living, and are to be considered as a most valuable increase of the population.

Finally, we would not omit to repeatedly emphasize that we, for our part, call the attention, by publishing the respective American regulations in prospectus, circulars, instructions for our agents, tickets, etc., in short all printings considered proper for this purpose, explicitly to the regulations of the American law which prohibits the

immigration of cripples, criminals, etc., and our officials are bound to exercise at the despatch a strict control, also to assist the authorities in every way fully and entirely in their measures.

The American consul at Hamburg, in reply to inquiries, says:

1. The number of persons emigrating over Hamburg to the United States for the last five years has been the following:

Year.	Direct.	Indirect.
1885	51,459	14,154
1886	47,213	40,226
1887	42,985	24,368
1888	52,575	32,153
1889	44,590	25,255

The season of 1890 having opened much earlier than usual on account of the favorable weather the steamship lines running from Hamburg to America expect a much greater number of emigrants to go over Hamburg than in the previous year, particularly as the Hamburg-American Packet Company has started a new line of twin screw steamers to the United States and built a number of other slower but very commodious and seaworthy vessels.

2. Your next question, "What is the ratio of rustic to urban emigrants?" is very difficult to answer. No records are kept here in regard to this matter, and the only means I have to arrive at something like an approximate information on this subject is to consult the records kept here as to the trades or occupations of the emigrants. Hamburg is, I believe, the only port that keeps such a record, but the figures apply to *all* emigrants leaving this city for foreign ports, and not only to those departing for the United States. The latest figures accessible are for 1888, and show the following aggregates:

Persons engaged in commerce	12,926
Persons engaged in agriculture	6,594
Factory workers	10,492
Laborers	29,273
Mechanics	819
Not stated	28,633

3. The greatest number of emigrants coming through this port on their way to the United States at present is from Russia. The Germans passing through here at present are mostly from the eastern provinces, Silesia furnishing our largest contingent. For the summer, however, a large number of emigrants from Schleswig-Holstein and Mecklenburg is expected.

4. The Russians going over now are a pretty good class of emigrants. They come in a great measure, from the German, or rather Baltic, provinces of Russia, leaving their own country on account of the religious persecution they are subjected to by the orthodox Greek Church. The greatest part of them are Mennonites. The emigrants from Silesia, Schleswig-Holstein, and Mecklenburg are likewise for the greater part very good, but those hailing from the Polish provinces of Prussia, Russia and Austria, from Slavonia and Hungary, are of a less desirable character.

5. It is very hard to find what proportion of the emigrants going to the United States are socialists or anarchists, but from the very large number of people here, particularly those of limited means, who hold such tenets, I judge that a very large proportion of the emigrants going to the United States are socialists. Of the more highly educated socialists who are exiled or expelled from Germany, I believe the majority go to the United States.

6. In regard to pauper emigration I have not been able to find any authentic case

where an infirmary or poor-house or any German official from this district has sent paupers or criminals to the United States within the last years. I understand that the Hamburg police have a contract with the owners of some English steamers, who, for a consideration of 10 shillings sixpence, take all alien paupers found wandering in the streets of Hamburg to England, as this is cheaper and easier than to send them to America. I suppose they prefer to rid themselves of these people in this manner.

7. The amount of money taken over by the average emigrant is very limited. Over half of the steerage passengers that went to the United States in 1889, went on tickets prepaid for them by relatives in the United States. All that the steamship companies require of them is that they are not totally without means when they land in America I inclose one of the printed instructions given by the Hamburg A. P. Co. and the North German Lloyd to their agents, in which they state what they require before shipping emigrants.

8. The steamship companies endeavor, of course, to get as many passengers as possible, but outside of occasional reductions in the prices of passage, I do not believe that they try to stimulate emigration to any considerable extent. The German laws forbidding this are very stringent, and if it is done at all it is done in a very cautious and private manner. There are, however, a number of American railroad and land agents in Hamburg who attempt to stimulate emigration to their districts, although they have to operate very privately on account of the above-named reasons.

9. In regard to the introduction of leprosy, I do not believe that this disease is prevailing in any of the districts from which we get the emigrants coming through this port. As far as the danger from other contagious diseases is concerned, I do not think that there is much chance of any person who is himself sick getting into the United States, because all emigrants are subjected to three separate medical examinations. But I think that diseases are often brought into the United States by the baggage of emigrants from districts in which epidemics prevail, and believe that the only way to guard against this danger is to disinfect such baggage both on this side of the ocean and on the arrival of the baggage in the United States. At present no disinfection takes place, and this offers, in my opinion, an element of danger to the health of the people of the United States.

SCANDINAVIAN EMIGRATION.

Swedish immigration to the United States began upwards of two and a half centuries ago, so that it may be said that the Scandinavian was one element of the Teutonic stock which entered into the elemental structure of our population. The two hundred and fiftieth anniversary of Swedish immigration was celebrated on September 14, 1888, at Minneapolis, Minn., at which an oration was pronounced by Hon. W. W. Thomas, our present minister to Sweden. The first Swedish settlement was in Delaware. To Mr. Thomas is due the successful colonization of the most northeasterly section of the Maine wilderness, where a Swedish farming settlement was established a few years ago, now increasing in wealth and prosperity. Swedish immigration to the United States first became prominent in 1863. In eight years from 1880, 311,249 Swedes came to this country, a vast influx when we observe that the population of Sweden is but little more than that of the city of London.

The Swedes are most numerous in Minnesota, where 200,000 Swedes and their immediate descendants are now living. There is no immigrant who makes a better or more industrious citizen than the Swede. A nation which under Gustavus Adolphus redeemed Europe from imperial and ecclesiastical tyranny and which produced such a Washington as Gustavus Vasa to free his country, contains the intrinsic material which founded the American Republic. There is no disputing the value to our country of the light-haired, robust race which has given statesmen to States, a Linnæus to botany, a Berzelius to chemistry, a Swedenborg to religious aspiration, an Ericsson to invention, a Fredrika Bremer to fiction, a Jenny Lind and a Nillson to song. The Swedes readily acquire our language; our instincts of liberty are theirs; our northern climates do not repel them. The more Swedish immigration is mixed with our composite stock the more surely shall we grip those forces of political and physical life which first gave impulse to our national existence.

The Scandinavian nations also are contributing to the forecastle many of the sailors that are indispensable, if we are to create a foreign carrying trade, elements of our national career quite as indispensable to the potential navy as well as to the possible merchant-marine which everybody believes the United States should have, but which we all confess the nation is very slow in possessing. The Swedes, Norwegians, and

Danes a thousand years ago manned their viking ships which plowed their way out of the creeks and fjords of Scandinavia manned by the most daring and able sailors that ever walked the quarter-deck. Five centuries before Columbus sailed for the New World, these gallant Northmen crossed the Atlantic and found the western continent, but forgot to give the story to literature, although they made their marks on the rocks and left their sign-manual, since identified.

The descendants of these old sea-kings, more tame than they, now are important to a new people who face two oceans and have more miles of sea-coast and navigable lakes and rivers than any people under the sun.

The emigration from Sweden to the United States for several years averaged 40,000 to 50,000 annually, but is now slowly receding It is mainly peasant emigration, or, as our minister to Sweden puts it, "very agricultural." Mr. Thomas has this to say of the present movement from Sweden:

> The Swedish immigra tion to the United States is largely promoted by prepaid passages from relatives in our country, but I think Swedes going to America will average each to have $50 in their pockets. Gothenburg sends out three-fourths of the Swedish emigration, that is they sail via Gothenburg. Young men predominate. The stream mainly flows to the farm of the West and to the forests of the Northwest. They are good blood, worth $1.000 a head to us.
>
> The founding of New Sweden in Maine, only July 23, 1870, makes an epoch in Swedish immigration to the United States. Before that it all flowed West. The farmers and woodsmen of the Maine colony have remained there. The mechanics drifted out of the farming settlement, first to other towns in Maine then to other cities in New England. They did well and wrote back to Sweden for their friends. The result is that not only has New Sweden, Maine, grown to be a model agricultural colony of over 1,000 souls, but a hundred other *nuclei* have been formed in New England. Thus a portion of Swedish immigration has been turned upon New England, and the northeast of the United States, whose climate is suited to the Swede, now receives a portion of the enriching stream which before 1870 flowed altogether westward. Providence, R. I., now has 2,000 Swedes; New Haven, Conn., has 1,500; Bridgeport, Conn., has 1,200; Worcester, Mass., has over 5,000; Boston, probably as many; Portland, 500, and Piscataquis County, in Maine, 300, with 1,000 in Aroostook County in the same State.

These statements illustrate in a striking manner the position that our duty in the United States at present is directing rather than suppressing immigration, diverting it when it tends to become clannish, spreading it where it tends to become thin, and studying climatic adaptabilities, to remember that there are older States yet thinly populated, comparatively poor because of idle rather than because of barren soil, and that we ought to have the new west, to be sure, but also the new south, the new north, and the new east.

Speaking of the diffusive industrial tendencies of the Swedes, Minister Thomas makes the following interesting statement:

> Our Swedish immigrants, having accumulated money at their trades in cities, are now to a certain extent moving out and taking up abandoned farms in the neighborhood of New England cities. Many farms in Cumberland and York Counties, in

Maine, are thus being redeemed to culture, and children, old-fashioned tow-heads, one a year, are being contributed to populate the old red school-house on the hill. This very year Vermont, guided by the success of New Sweden in Maine, is transporting a colony of Swedes over the Atlantic to settle on the abandoned farms of the Green Mountain State. New Sweden is in fact the first successful agricultural colony founded in New England by foreigners from over the ocean since the Revolution.

The American consul at Gothenburg, Sweden, furnishes me the follwin detailed information:

The total emigration from Gothenburg to all points in 1889 was 24,998, and from January 1, 1890, to July 1, 1890, it has reached 15,425, all of which, with the possible exception of a very insignificant number, went to the United States.

The Swedish statistics as to the destination of emigrants are not thoroughly reliable, as all the destinations given by them for emigrants from Sweden are—besides the United States—Denmark, Norway, and Germany, to which countries they average yearly as follows: Denmark, 2,300; Norway, 1,500; Germany, 600, while all the rest are to America. A very small contingent formerly went to the Argentine Republic, but have now entirely ceased on account of the unfavorable economic conditions prevailing there. Australia has a slight percentage, a few hundred emigrating there each year, and Brazil has lately attracted a few, but it is insignificant as a whole.

It is estimated that the number of emigrants from Norway and Sweden this year (1890) will fall off at least one-third, as compared with the total of 1889. The majority of emigrants from this country may be classified as—about 10 per cent. from cities; some 7 per cent. as skilled artisans and mechanics; about 10 per cent. female domestics; and the remaining number farmers and common laborers, with their families.

As far as I know and can learn the Norwegian Government is apparently inactive in the matter of emigration, although, as I have mentioned elsewhere in regard to Sweden, I am perfectly sure that communities, municipal, and other authorities are very often instrumental in promoting the emigration of undesirable classes.

"As to the Swedish Government in this question, the laws regarding military service alone have considerable effect on emigration, as all the men in this country from nineteen to twenty-six years of years are obliged to perform some military service each year, and during this period they are denied a priest's certificate, without which it is unlawful for an agent to sell them a steamer ticket or forward them on a prepaid passage.

A steamship agent in Sweden is obliged to deposit a large sum, some 60,000 kroner, with the Government as security for any penalty that may be imposed for his disregard of the law. As a consequence, any man between the age of nineteen and twenty-six, wishing to go to America is obliged to make a special petition to the King, stating certain and specified reasons why he desires to emigrate, some of which are as follows:

"I am without work and means of subsistence, and have therefore concluded to emigrate to America, rather than become a burden to the community, as I have money enough to pay my journey with."

"I have concluded to emigrate because my father has a large debt on his farm, and in the hope of being able to help him pay off the same I wish to go to America."

"I have, through many sacrifices, succeeded in saving money enough for a ticket to America, and in order to assist my poor parents, that they may not become a public charge in their old age, I desire to go to America."

The number of applications to the King from would-be emigrants aged nineteen to twenty-six, subject to military duty, is large, and amounted two years ago to some 6,000. Although many permissions are granted, the number of applications has become too voluminous for speedy dispatch, and is continually augmenting, thus

further acting as an obstruction to this class of desirable emigrants. Possibly this is one object of this measure, as a somewhat similar provision in Finland, requiring the intending emigrant to make his application to the senate, is there admitted to be the intentional hindrance of emigration for the purpose of preventing a scarcity of the laboring classes.

A considerable number here, however, evade the law by going to Norway, Denmark, and Germany, and procuring further passage there. This will be found to be one of the causes of the discrepancy in the Swedish official returns of the number of emigrants from Sweden and the number of Swedes entering the United States as shown by the Treasury Department's statistics of immigration.

The nationalities passing through this port are Fins and Swedes. The number emigrating in 1889 were respectively: Fins, 7,000; Swedes, 17,998. Up to July 1, 1890: Fins, 2,500; Swedes, 12,925.

Although such things are difficult to substantiate, still, from my own observation and from circumstances I have heard related and occasional incidental accounts in the press, I am thoroughly satisfied that criminals, vicious characters, paupers, and other objectionable persons have been and are constantly being assisted to America for the purpose of getting rid of them; and I doubt very much if there is a single hamlet, village, or any other community, not to speak of the large cities, in the whole Kingdom which could not furnish instances of such a practice.

I believe this is principally done by private subscription by members of the community to rid themselves of objectionable characters; but I also am perfectly confident that it is done as well by the officials of prisons, poor-houses, and other institutions, for the reason that, careful as the press is about publishing anything reflecting unfavorably upon their country or institutions, occasional instances inadvertently, or in other connections, appear in print.

Mormon emissaries are continually at work in Sweden, but they carry on their operations very cautiously and secretly, as, if it becomes known that their proselytes have signed the contract or agreement with which they bind them, agents would not be allowed to sell them tickets to America. This difficulty, however, is obviated by such converts crossing over to Denmark and there taking the Danish (Thingvalla) line to New York. The number so doing is estimated by competent authority to have been about 500 in 1889.

There is no medical inspection whatever of intending emigrants. I have never heard nor can I learn of any one having been refused passage on account of his or her physical condition.

I have never seen a case of leprosy in Sweden to my knowledge, but, as a fact, it exists here to a considerable extent. Although the number of those afflicted with the disease can not be obtained, the statistics of deaths resulting from it, as given in the official statistics of the Swedish board of medical directors, show that, during a period of twenty-six years, from 1862 to 1887, there was a total of 873 deaths, averaging 33.5 per year. The latest figures available now are for 1887, when 16 deaths were recorded. A few weeks ago a female leper, upon her arrival at New York, was, most fortunately, detected and returned to her home, a few miles north of Gothenburg.

In Norway there are special hospitals or asylums set apart for this tainted class, and a noted Norwegian dermatologist estimates the number of lepers at the present time in that country at 1,000.

Beside leprosy, the only contagion of moment is smallpox, which exists in a sporadic form, and scarlet fever, which prevails constantly to a considerable extent.

Causes tending to the promotion of emigration seem rather to be increasing than diminishing in Scandinavia, and may be found largely in the economic conditions and the hard struggle of the farming class against the combined difficulties of worn-out soil, and adverse climate.

Compulsory military duty no doubt has a certain weight in the question—but as

the service is very light, consisting of a few weeks' duty each summer for a few years—its influence in this direction is comparatively slight.

Undoubtedly the main reason lies in the hope of bettering their financial condition and gaining more personal freedom, which accounts of the improved fortunes of relatives and acquaintances in America tend to strengthen and augment; while on the other hand statistics in Sweden show that the economic status of the people is not improving, as the number of paupers is steadily increasing; the latest records showing that 5.10 per cent. of the total population are a charge upon the public.

It has been stated before the National Economic Society in Stockholm that it is estimated that the cash capital carried out of Sweden to the United States averages 150 kroner ($40.20) for each emigrant.

During the period from October to March the number of emigrants from this port is as 1 to 7, compared with the remaining months. The largest emigration takes place in April, May, and June; and the lowest during December, January, and February. The lowest number of emigrants from this port in 1890 was, as is usually the case, in the month of January, and was 488.

During the months of June, July, and August the number of returning emigrants averages about 250 per week, and in November and December between 400 and 500 per week. The majority of these are supposed to be merely visiting Swedes, who come to spend a few weeks at midsummer, or Christmas, and return afterwards to the United States; but I am strongly inclined to suspect that some of these go over to work during the summer season in America when labor is in good demand, and come home to "winter over" where living is cheap. Reliable authority states that only about 3 or 4 per cent. of this number remain here permanently.

Of the emigrants leaving this port, about one-third have heretofore been forwarded on prepaid tickets, but this number seems to be increasing, as the emigration up to the 1st of July, 1890, shows the proportion of prepaid tickets to be over one-half of the entire number of passages. The greater portion of the assisted passages are for adults; such passages this year, up to July 1, show a total of 9,597, of which 8,572 were for adults.

To my mind, the provisions and regulations of our national quarantine system, and Marine Hospital Service, together with the instructions to officials abroad, tending to protect our people from contagion, seem very complete, and well adapted to the end aimed at.

The United States consul in Christiania, Norway, writing July 25, 1890, says:

(1) The total emigration from Christiania in 1889 to all points was 8,010; of these 7,985 left for the United States.

The emigration during the first six months of the present year was 4,605; of whom 4,579 emigrated to the United States.

(2) In 1889 11 emigrants went to South America (Buenos Ayres), 13 to Australia and 1 to Asia. In former years a larger number of emigrants has gone to Australia and a small sprinkling has also gone to South Africa.

(3) The emigration from this port to the United States will in 1890 hardly reach the figure of 1889, owing to the better times here and the increasing lack of working men in Norway and Sweden.

(4) In 1889 of 8,010 emigrants 815 belonged to this city and 4,807 came from other places in Norway, the most of whom probably from the country districts.

(5) From the official statistics on emigration for the year of 1887, when 10,789 emigrants of Norwegian nationality left this country, I see that 1,055 are classified as farmers, farming hands, or persons engaged in lumber work; 1,356 are skilled artisans, but besides these 4,511 persons are styled as day laborers or others, whose professions are not sufficiently given; most of these are in my opinion people from the country, belonging to the agricultural classes.

(6) The Norwegian Government has never made a single step to promote the emigration to the United States of paupers, criminals, and others to whom the United States object, or tried to do anything to retard or hinder the emigration of such emigrants who may become useful and desirable citizens of the United States.

(7) The nationalities of the 8,010 emigrants who in 1889 left over this port were given thus: Norwegians, 5,636; Swedes, 1,663; Americans, viz, persons returning to America after a short stay here in their native land, 711.

(8) As far as I know from an experience of about twenty years, no paupers, cripples, criminals, or other persons whom we do not want are smuggled through this port to the United States. I, however, had a single instance last year, and I call it an exceptional case, when I heard by an accident that the poor board of the town of Kongsberg had supported a troublesome person to emigrate to the United States. I immediately gave notice of it to the collector of customs of the port of New York, and the authorities there succeeded in finding the man somewhere in the State of New Jersey and of transporting him back to Norway, where I had informed the police authorities of the part I had taken in his sending back.

As a rule, I must say that the Norwegian authorities would not dare to send their poor or criminal ones to the United States in order to get rid of them, and that they are perfectly loyal to their duties towards the United States.

(9) The Mormons are still working here and I regret to say with some success. Their number at this city may be given as about 400, but the recruits for America go, if I am not wrongly informed, always over Copenhagen, which is the center of Mormonism in the north.

(10) The laws or police regulations of Norway order a medical scrutiny of all persons emigrating from the country, but I think it is only a very superficial one. The inspection, however, is enforced in every case. No emigrants have, to my knowledge, been rejected for disease during the past eighteen months.

(11) Of contagious diseases, scarlet fever and diphtheria have been prevalent for several years at this city. The sanitary board here is active and efficient, and the hospitals are modern and in good condition.

(12) The 8,018 persons emigrated over this port in 1889 were reported to have carried with them kroners 52,600, or about $14,000 in our money. Most of the emigrants and chiefly those who have had their passages prepaid in America, have very little money with them, carrying only a strong body and a cheerful hope of a bright future in the United States.

(13) At the beginning of the winter hundreds of Norwegians settled in the United States have for some years past returned to their old homes, but only to return to the new country after a short visit. Some, but in proportion to the returning emigrants very few of them, remain here enjoying the fruits of their work in America.

(14) More than half of the number of emigrants have assisted passages through remittances from friends in the United States. In 1889, when, as already said, 8,010 emigrants left this port, 4,148 had their passages prepaid from America, and the assisted passages were, in my opinion, more for families than for adults.

(15) Some precautions should, in my judgment, be taken by the United States to prevent the importation of leprosy from the western and northern districts of Norway. A stricter inspection of the emigrants should be made, and all emigrants hailing from the districts infested with that malady should produce a certificate from their respective boards of health or district physicians as to their own and their families' sanitary condition.

EMIGRATION FROM GREAT BRITAIN AND IRELAND.

For the eight months of 1890 ending August 31 as compared with the corresponding months of 1889 there was a decline of 7,426 in the total number of English emigrants to the United States; in Scotch emigrants a decline of 3,348, and a decline of 6,321 in Irish emigration. The total decline of emigrants of British origin in this period as compared with the corresponding period of 1889 was 17,195; the total for this period of eight months in 1890 was 106,123. No doubt the advance in wages in several callings in Great Britain wrested from British capital by the remarkable series of successful labor mutinies of the last half of 1889 and the early part of 1890 has had some influence on the emigrant movement from Great Britain, together with the prosperity of general business of which these successful strikes were an abnormal symptom.

This explanation appears to be reënforced by the comparative statistics of British emigration to points outside the United States, for it is significant that British emigration to Australia, British North America, and other points has fallen off in larger proportion than to the United States; showing that our country is yet considered to be a more desirable home for the best classes of British emigrants than any one of the British colonies, notwithstanding the tremendous amount of effort made in high and influential circles in the United Kingdom to swell the emigrant stream that flows outward through its chief ports. More than twice as many Englishmen annually settle in the United States as settle in the Dominion of Canada. Over four times more Englishmen have come to the United States to settle from January 1, 1890, to August 31, 1890, then have gone to Australia. In the past eight months upwards of 11,000 Irish have moved on points outside the United States, while this country has absorbed over half of all Scotch emigration. In round numbers the United Kingdom has sent to the United States in the eight months of 1890 above named about 60 per cent. of her total output of population.

But there is another important feature of this insular emigration. Hull, Leith, London, and Liverpool are points which are the lodging places or temporary homes of a large foreign emigration, most of which passes directly to Liverpool by rail from Hull, from Leith to Glasgow. London sends out comparatively few emigrants. The doors of British emigration swing from the west as well as toward the west. Liverpool is the great way station of the Continental movement that touches England. In the past eight months, from January 1, 1890, more persons of Continental races have sailed to points outside of Europe from ports of the United Kingdom than Irish, and almost as many as of Irish

and Scotch together to all points, and about 7,000 more than the English emigration to the United States for the same period. About 33 per cent. of ostensibly British emigration (*i. e.*, emigration moving abroad from British ports), is German, Scandinavian, Russian, Austrian, and Continental European.

The sharpness of English competition for the emigrant traffic is obvious when it is observed that in steam-ships sailing from British ports in the first eight months of 1890 upwards of 63,000 steerage passengers were induced to cross the North Sea or the English Channel in order to find the steerage of ships sailing particularly from Liverpool and Glasgow. The keenness of British zeal for the world's carrying trade is matched by its zeal in moving the world's uneasy population. It is no uncommon thing to find Babel reproduced in the steerage of an English steam-ship as she moves out into the Mersey bound for New York.

The comparative statistics of the eight months here being dealt with (which include the heaviest fraction of the movement for the entire year) reveal another interesting fact, namely, that while emigration to the United States from the English-speaking races has declined moderately in 1890 as compared with 1889, the emigration of races not speaking English has increased in general from most points, and in particular from points in the United Kingdom.

In the first eight months of 1889 there sailed from British ports 52,575 persons of continental races; in the same period of 1890 the number was swollen to 57,314. Exact statistics concerning the proportion of races concerned in this movement are not at hand, but there are indications that the proportion of Russian Jews is larger than in 1889.

The following is the statement of British emigration for the present up to September 1, 1890, issued by R. Giffen, esq., the statistician, and is dated September 4, 1890, issuing from the commercial department of the Board of Trade, London:

Return of the numbers, nationalities, and destinations of the passengers that left the United Kingdom for places out of Europe during the month ended August 31, 1890, *and the eight months ended August* 31, 1890, *compared with the corresponding periods of the previous year.*

MONTH ENDED AUGUST 31.

Nationalities.	United States.		British North America.		Australasia.		Cape of Good Hope and Natal.		All other places.		Total.	
	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.
English	11,773	11,886	2,296	2,823	1,824	1,935	812	1,520	596	732	17,301	18,896
Scotch	1,897	2,211	256	276	207	194	57	93	52	41	2,469	2,815
Irish	4,648	4,608	223	318	323	272	31	22	40	18	5,265	5,238
Total of British origin	18,318	18,705	2,775	3,417	2,354	2,401	900	1,635	688	791	25,035	26,949
Foreigners	8,067	6,439	910	564	30	51	220	233	119	137	9,346	7,424
Nationality not distinguished	.....	1,232	.....	.....	.....	.....	5	.....	230	254	235	1,486
Total	26,385	26,376	3,685	3,981	2,384	2,452	1,125	1,868	1,037	1,182	34,616	35,859

Return of the numbers, nationalities, and destinations of the passengers that left the United Kingdom for places out of Europe, etc.—Continued.

EIGHT MONTHS ENDED AUGUST 31.

Nationalities.	United States.		British North America.		Australasia.		Cape of Good Hope and Natal.		All other places.		Total.	
	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.
English	56,236	63,762	14,225	18,284	10,108	14,298	6,403	8,192	5,439	6,306	92,411	110,842
Scotch	9,769	13,117	2,020	3,264	1,405	1,570	589	635	459	359	14,242	18,945
Irish	40,118	46,439	1,292	1,720	1,710	1,889	82	89	243	1,717	43,445	51,854
Total of British origin.	106,123	123,318	17,537	23,268	13,223	17,757	7,074	8,916	6,141	8,382	150,098	181,641
Foreigners	57,314	52,575	7,638	8,273	230	344	1,197	1,032	1,016	831	67,395	63,055
Nationality not distinguished	.....	1,232	.....	.....	.....	.....	6	3	1,621	1,716	1,627	2,951
Total	163,437	177,125	25,175	31,541	13,453	18,101	8,277	9,951	7,778	10,929	219,120	247,647

NOTE.—The above figures, being made up at the earliest possible date after the close of each month, are subject to correction in the annual returns.

Cycles of action and of reaction corresponding with cycles of trade affect emigration. There are periods in which emigration from the United States is suggestively large in comparison with the immigration. In the United Kingdom these cycles have been more definitely marked by statistics than has been done in the United States. A period of decline of emigration and an increase in immigration into Great Britain and Ireland is generally followed by the reverse. First, there is a rise from a period of low emigration with slight changes in immigration, then an increase of both; then a decline in emigration, accompanied by an increase in the returning current and finally a decrease of both, but net emigration, of course, being the largest.

The detailed statistics of British and Irish emigration in 1889 are suggestive: 20,219 married women, 24,458 children twelve years and under, and 14,642 married men last year emigrated from the United Kingdom to the United States, showing, among other facts, the increasing tendency of families to join their heads in the New World. The number of emigrating single men in that period was 69,218 and of single women 40,234. In the year's British emigration there were nearly 5,000 professional men and merchants and about 10,000 mechanics of the building trades. In the year 1889 the following numbers of continental races moving to the United States used British ports as a way station: 20,568 married men; 27,736 married women; 35,787 children, twelve years and under; 101,478 single men; 54,829 single women. Here is the same increasing tendency of emigrants in the United States to send for their families as well as a decided movement of the advance guard of married men. It is a fact worthy of note that there is a preponderance of male over female children in both classes of emigrants here alluded to. The variety of trades among these emigrants is wide, but unskilled labor of course enormously preponderates if we include in this class the land workers.

The largest percentage of emigration as compared with the population of the United Kingdom was in the period of five years 1881–1885 inclusive. The excess of males over females is considerable in the emigration from Great Britain, but the phenomenon of Irish emigration is the large proportion of females. In the past ten years the statistics of two years show a slight excess of women emigrants from Ireland. In the decade closing 1889 the percentage of children emigrants varied from 14.9 to 22.5. In that decade the excess of male over female emigration, both foreign (passing through Great Britain) and from the United Kingdom, to all points, was 791,141. In the same period 665,879 children from the same territory were poured into countries outside of Europe from the British Isles. If the Christian crusade was a unique religious fact of the Middle Ages, the children's crusade of the close of the nineteenth century is a unique social phenomenon.

There are curious roundabout movements of immigrants to the United States other than those hitherto mentioned, due to the competition of steam-ships for business. One of these is via Rotterdam. Many foreigners come from the continent to London, remain awhile, take small ships to Rotterdam, recrossing the channel, and thence sailing to New York. This route is extensively advertised and rates are low. In this way, especially, the undesirable congestion of the poor in the east end of London is relieved. There is no evidence of emigration being assisted out of public funds, but there are indications that private charity moves some who are liable to be a public charge from the east end of London to New York. The Wilson line from London carries but few emigrants—not over 1,000 a year to New York. The Allan line takes about 6,000 a year from London to Canada, of whom it is believed many are assisted. A very few Germans sail via London to the United States, such generally as fail to make both ends meet in London.

In reply to inquiries as to the emigration from and through Glasgow for the first half of the year 1890, the marine department of the London Board of Trade, the focus of British statistics, replies as follows:

> In reply to your letter of the 29th ultimo, addressed to the principal officers of this department at Glasgow, asking for certain information respecting emigration from that point, I am directed by the board of trade to transmit for your information the accompanying statement showing the number of emigrants who left the Clyde for places out of Europe during the first six months of 1889 and 1890, together with a copy of the statistical tables relating to emigration and immigration from and out of the United Kingdom in the year 1889.
>
> The board further desire me to state that they are not aware of any case where passengers booked by agents have been rejected except where the full fare has not been forthcoming or when more passengers have been booked than the ship could accommodate, in which latter case they are sent on by the next vessel. Passengers are, however, occasionally rejected by the medical officers as unfit to proceed on the voyage.

Statement showing the number of emigrants who left the Clyde for places out of Europe during the six months ended June 30, 1890, and the corresponding period of the previous year.

Destination.	*1890.	1889.
United States	11,218	12,354
British North America	1,780	2,479
Australasia	153	166
Other places	70	24
Total	13,221	15,023

* The figures for 1890 are given subject to correction.

EMIGRATION FROM GLASGOW.

In 1888 there was first prominent in Scotch emigration a well-to-do farmer class, worth from $1,500 to $4,000 each, together with young physicians and other professional men. Since that period many Scotchmen have taken ranches in the wild West, while many others have gone to Florida, where a Scotch capitalist preceded them in large purchases of land to which he has won many small purchasers of his own countrymen, now employed in orange culture and in raising vegetables for the Northern market. The climatic conditions in which these Scotch emigrants were reared would seem to forbid any very extensive movement of these people to Florida, but since the British occupation of India, the adaptability of superior races to all the inferior or enervating climates has been marvelously illustrated, so that it is disloyalty to the historic method longer to affirm that the Anglo-Saxon is incapable of the cotton field or the orange groves of our Southern States.

JEWISH EMIGRATION FROM GLASGOW.

Glasgow probably is the most crowded city for its space of occupation in Great Britain. Twenty per cent. of its population lives in one-room tenements and 45 per cent. in two-room tenements, and yet many a rural neighborhood in the north of Scotland sends more emigrants than does Glasgow. But Scotch emigration for several years has been declining, while the foreign emigration through the Clyde has been increasing to about 75 per cent. of the whole. The continental emigration via Glasgow is very largely Jewish. The United States consul at Glasgow recently discovered a Jewish family of five children with the mother in needy circumstances who were being aided to emigrate to the United States, and of course he stopped them by the assurance that they would not be allowed to land; but in all probability they have got there ere this by some other form of journey.

In single steam-ships from Glasgow for New York one finds as many as two hundred of these poor peasants from Russia, at least 90 per cent. of of whom are moved out of Russia by prepaid tickets or by passage assisted

by the Jewish benevolent societies, whose self-denying loyalty covers every child of Abraham, no matter what his condition in life may be. The masters of the world's banking are masterly in their charity for their persecuted race. If you ask these Hebrew emigrants (the men) what they propose to do in the United States, as a rule they will reply, "I shall sell." Most of them will be peddlers. The extent to which organic Jewish benevolence assists these pitiable Russian emigrants into the United States, I think, is not appreciated in our country. This great philanthropic movement within a race is at once a monument to the power of the better sentiments in our century, and a witness of the tremendous activity of persecution in effecting the solidarity of a nation without either a capital or a country.

A peculiarity of German Jews of the poorer class is this: That they become socialists as soon as they learn to read. The extremists of capitalistic centralization on the one hand, as well as of communal or of socialized wealth on the other hand, may be found in the Jewish emigrant. In one ship which recently left the Clyde for New York were Russian Jews too poor to have even an opinion, German Jews of well informed socialistic bias, and Jewish millionaires (the latter in the first cabin). The founders of German socialism were Jews.

A visit to the Jewish Emigrant Lodging Home, where the continental Jews halt for a night or two prior to the departure of their ships, enables one more vividly to appreciate the force of the foregoing. These emigrant lodging-houses in Glasgow, as throughout the Kingdom, are under police surveillance. At the side of the entrance to one of these Jewish lodging places in Glasgow one finds a locked door. Within is the cook-house, where a Jewess cook is preparing special food from meat slaughtered under ecclesiastical care. The dishes have never been defiled by Gentile touch. Only hind-quarters are used. An immense caldron is boiling with bouillon, unsullied by alien hands.

In the chief apartment of the lodging-house of which I am speaking I found perhaps two hundred emigrants, all from Russia, interviews with numbers of whom will resolve the types. Says one: "I am a carpenter; going to New York to join my brother." Says a second: "I shall go to Pittsburg to peddle." Sixty young girls are going to Pittsburg and Philadelphia to join friends. All of these people are miserably poor; not a few are barefooted and ragged, and most of them give evidence of having been ill-fed. One family reported having been driven from their German-Russian province by the Russian police for no other offense than that of race, and for no other fault than that of poverty. Permanent residence in Russia was denied them. They must be wandering Jews if they stayed in the Russian territory, and forced change of residence drove them to America. There was one very interesting and intelligent family, consisting of an elderly lady, her son, and daughter, whose father was in America and had sent them money to emigrate. There were fifty children in this group of Jewish emi-

grants. There was a consensus in substance like this: "We were all starving in Russia; persecution sought us out; we are fleeing to an asylum in the New World." It was impossible to look into their starvelingly-pinched faces without sympathy.

Various others of these emigrants, representing the more numerous body of males, reported themselves to be peasants going to New York without trade or purpose, knowing not what would become of them except that they should "peddle." The worst physical depression was a wretched, half-clad mother with three babes, triplets, the babes nude save a dirty kerchief tied about the loins of each. It is not easy to exaggerate the squalor and misery of these Russian emigrants thus corraled, as it were, apart, too lowly for other emigrant races, isolated in the lodging-houses and generally in the steerage passage. The condition of the steerage filled with such passengers during a long storm in the transatlantic passage I have personally witnessed at peril to sanity, sanitation, and digestion which decent language fails to portray.

In an apartment or in another compartment of the large room in which these Jewish emigrants were quartered in Glasgow were a group of Scandinavian emigrants, in striking contrast with the preceding group—cleanly, better fed, the subjects of comparatively good government and opportunity. Yet not a few of these Russian Jews may be seen in the decks of the steerage and in their lodging-houses, reading the Hebrew Scriptures or cowering behind the cordage and thumbing or re-reading silently or aloud to their friends the last letters that came to them before they entered on their exile.

The United States consul in Glasgow, referring to the "100,000 emigrants," more or less, "who annually leave the Clyde," writes:

> I have often walked along the quays of the Clyde especially to see what sort of people are emigrating to the United States. There is perhaps no port of embarkation for emigrants to the United States which needs more careful investigation than this, as steerage passage, I understand, is lower here than almost anywhere else.

The results of investigations in emigrant lodging-houses, re-enforced by the testimony of emigrant agents, such as will be given later on in describing the Liverpool movement, seem to justify the consul's suspicions.

I asked our consul in Glasgow to address to the various steamship lines in Glasgow taking passengers to the United States certain questions. The replies received were as below. It should be said that the Scotch who find the New World via Canada sail mainly by the Allan line. The letters alluded to read as follows:

65 GREAT CLYDE STREET,
Glasgow, August 7, 1890.

In reply to your favor of the 4th instant, we beg to inform you that the number of emigrants carried by our steamers this year is somewhat less than during the same period in 1889, the number being 4,720 this year against 5,280 in 1889. Very few of our passengers are to our knowledge assisted by any of the benevolent societies. We

have had to reject an exceedingly small number of applicants for passage, certainly not more than in the previous year, the chief reason being that they were of unsound mind. The largest proportion of the emigrants by our vessels, other than British, have come to us via Hamburg, and are chiefly Jews.

We are, yours, very truly,

D. A. B. MURRAY,
For the STATE STEAMSHIP COMPANY (Ltd.),
John Brace Murray, Manager.

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45 UNION STREET,
Glasgow August 4, 1890.

SIR: We beg to own receipt of your favor of this date. We, in reply, assure you emigration to America this year is less than it was during 1889. No benevolent society has forwarded any emigrants by our steamers.

We have not had any occasion to reject applicants for passages; all persons must pay their fares. Next to emigrants from Great Britain and Ireland we carry—in number—Germans.

Yours, very truly,

HENDERSON BROTHERS.
N. W. AITCHISON.

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25 BOTHWELL STREET,
Glasgow, August 6, 1890.

DEAR SIR: We duly received your letter of 4th instant and have pleasure in giving you the information you desire therein. The number of passengers carried by our steamers to United States ports during this current year is less than carried during the same period of 1889. We have had no passengers sent to the States under the auspices of benevolent societies.

We do not keep any record of persons to whom we refuse to grant passages, and we are therefore unable to give you the number rejected. After British passengers the majority of emigrants by our steamers to the States were Scandinavians.

Yours, truly,

JAS. & ALEX. ALLAN,
Per N. H. DUNLOP.

EMIGRATION FROM LIVERPOOL.

It is in Liverpool that very suggestive studies of the transportation of all grades of population may be made and where there may be found the most diverse and varied social and economic conditions between the short strides which separate first cabin from second, and second cabin from steerage. Probably over a thousand steamships in 1890 have been concerned in bringing steerage passengers to the United States and perhaps well-nigh to a thousand to the port of New York alone; but in no port do transatlantic voyagers swarm as they swarm in Liverpool. If many races converge in this movement through other ports, all races converge here to move on the New World.

The disposition of the chief representatives of foreign steam-ship lines toward the United States is generally kindly, so far as my observation has extended. Especially is this true of the German and Bel-

gian lines, as well as those of southern Europe. But an exception must be made in this respect in the case of the representatives of one or two of the trans-atlantic lines centering in Liverpool. One line refused, point-blank, to make any written reply to certain inquiries not hitherto supposed to have been impertinent. Another line appeared to view as an impertinence what was requested as a courtesy. It would seem that great trans-atlantic lines doing such enormous and profitable carriage to the United States might wear an easier-fitting collar even when condescending to the humblest person authenticated by the State Department and authorized to prosecute certain lawful inquiries.

I am glad to say that the central foreign office of but two of the many lines of steam-ships engaged in the forwarding of European emigrants displayed absolute irritation, while a third froze out inquiry with frigidity of courtesy. I was enabled, however, from other sources to obtain interesting facts bearing on emigration from Liverpool. It should be added that the irritation and frigidity displayed perhaps may have been due to the fact that the steam-ship lines alluded to have been among those forced to bring back to Liverpool from ports in the United States persons whom they carried out in violation of our laws. The courtesy of the Liverpool heads of the Inman and Anchor Lines was in such marked contrast to the discourtesy of two other lines that simple justice requires this mention. The White Star Line also readily acceded to my requests; but as I was unable to cover the whole ground through the steam-ship lines, I dropped that method of inquiry altogether in Liverpool and sought out unofficial and lay persons connected in some way with emigration. The most interesting feature of these Liverpool inquires relates to Mormon emigration, of which I will speak later on, in this section confining myself to other features of the Liverpool movement.

An emigrant sub-agent thus speaks:

> Many excellent emigrants pass on to the United States through Liverpool from Scandinavian nations, especially from Copenhagen via Hull. I think, as a rule, there has been an improvement in the quality of Liverpool emigrants. Large numbers of good, skilled farmers are joining what I call the skilled-labor movement to America. I believe the great majority of passages hence areprepaid. There is a steam-ship syndicate which divides the continental steerage traffic on a certain basis. I have seen shabby looking emigrants in the steerage, whom you would have fancied quite penniless, who had $2,500 in their belts. It does not always do to conclude regarding the Jewish peddlers, for instance, that they are poor, though in most cases they are; but some of them try to make you believe they are paupers, when in fact they have a good supply of money. They carry their own utensils on board ship, brew their Russian tea, and live on an especial diet. We forward passengers, third class or emigrant, for $40 from Chicago to Copenhagen, and $75 for the round trip, rail and steam-ship, thus securing a considerable returning and tourist stream of the emigrant class.
>
> There is a society in London with branches in Liverpool which gives assistance to get rid of European paupers or poor that might otherwise become a charge on English cities. Many of the Poles and Russians, the poorest of their class, come here via Hull to sail for the United States.

The scouts of booking agents are plenty in Great Britain, and in the sea-ports especially. Nothing that can be done is omitted to get anybody and everybody to buy a ticket for "the States." Yesterday I saw on board ship bound for New York a woman and child who were penniless, having only their prepaid passage, but they expected to reach husband and father in New York.

The evils of immigration are largely perpetuated by large contingents of persons more interested in increasing the quantity than in improving the quality.

I do not know how much reliance can be placed on the following statements made to me by a veteran emigrant drummer of Liverpool, but as they cover a ground on which it is very difficult to get exact testimony and confirm suspicions which exist in the minds of many United States officials in Europe, I subjoin them:

I think that at least one hundred very objectionable emigrants leave Liverpool every week for New York. Some of these, and perhaps the most objectionable, are British paupers assisted by benevolent secieties; some of them are ex-convicts, but the most of them are paupers from the continent—I mean persons without a cent of money or an outlook or trade or habits of industry or of self-support. There is an agent in Liverpool who takes ex-convicts, sees them on the ship, and pays them their 'good behavior money,' after paying their passage to the United States. They are furnished with a new suit of clothes, and are given to understand that they can do better abroad than at home. They have something over and above their tickets. The Government is not concerned in this matter, but they get to America on British funds.

No, there are no Liverpool paupers sent hence to the United States, so far as I know. You can not get a Liverpool pauper out of Liverpool with a ship's windlass. They will stick here and starve rather than go abroad. It is the European (continental) poor and the English country poor that are mainly included in the poorest emigration. The sub-agents have a hard time to get a living because there are so many of us. We get 5 per cent. and the agents who do no work get 7½ per cent. There are drumming agents in every village in the country, urging men and women to emigrate. Some do not decide where they will go until they get to Liverpool. They sell their little all for what they can get and hurry off. We pick up a few of the floaters here in Liverpool. We have pamphlets and give information. I have known of criminals whose term was shortened for good behavior who are dumped on the States. Poor rates are so high in England that those outside official quarters are interested in seeing off those likely to become a public charge as well as those who have become such charge.

On board a ship about sailing from Liverpool to New York were two emigrants about whom there was some confusion. There was a division reported in medical judgment. The physician of the Board of Trade declared them unfit to proceed; the ship's doctor could find no reason why they should be prohibited. It was not announced whether these persons sailed or not; but the incident shows that a medical examination under United States auspices at European ports might keep our Government in better touch with the problems or the factors of the problems of emigration.

On the same ship were several drunken men so disorderly that the police ordered them into secure places in the steerage below.

On the other hand, some of the first-cabin passengers on this ship were returning emigrants who had gone to the United States in the

steerage on a former passage. Larger numbers on the ship here referred to were making their second journey to the United States.

Our Consul at Liverpool writes as follows:

Emigration in 1890 will not, in all probability, be nearly so large as in 1889. No statistics are kept at this port as to the classes of emigrants; so it is impossible to give any estimate of the proportion of those leaving cities—of artisans or of farmers. It is also impossible to say what dangerous classes from the continent reach America. From all that can be learned on the subject paupers are not assisted to emigrate by benevolent societies, nor is there any contract labor sent from England to America. Cripples are certainly not sent over. But it is impossible to tell about the emigration of dynamiters.

As usual for thirty years past, Mormons are going to the United States this season. They come from all parts of Germany, Scandinavia, and Great Britain, and indeed from almost everywhere. They are recruited by missionaries, who preach openly throughout this country.

All emigrants are subjected to a careful medical examination before leaving this port, and any one suffering from a contagious disease is refused transportation to the United States. No case of leprosy has been heard of at this office.

There is no means of ascertaining the average amount of money that emigrants take to the United States. It is well-known that most of them go out to the far West and pay their own railroad fares to such distant points, besides having enough money to start life in new homes, so it is to be supposed that a large class of emigrants are thrifty and industrious.

The difference between summer and winter steerage rates hence to the United States is very small, a couple of dollars at most. The steam-ship companies here greatly desire to transport the Scandinavian emigrants to the United States, but ships going directly from Scandinavian waters compete as keenly as possible for this class of passengers.

IRISH EMIGRATION.

Queenstown is the point of embarkation of Irish emigrants almost exclusively, and comparatively few Irish emigrants sail from any port out of Ireland. The emigration from Queenstown in the first half of the year 1890 was 20,676, which is about two-thirds of the gross emigration from that port in 1889. There is but very little emigration from Queenstown to any other country than the United States. Eleven hundred more saloon passengers arrived at Queenstown in the first six months of 1890 than in the corresponding period of 1889, while there was a falling off of 6,500 in the number of steerage going out in the same period. By far the larger number of emigrants to the United States from Ireland are young men and women, unmarried, of the farming and laboring class. Only about 5 per cent. of the Irish emigration is skilled workmen, a respect in which English and German emigration is superior.

The United States consul at Queenstown reports that in 1890 he has learned of no Government assisted or pauper emigration to the United States, although he states that occasionally local poor-law guardians assist worthy young girls reared and trained in the work-houses, to

emigrate as servant girls. As a rule the emigrants from Ireland are looked upon at home as the bone and sinew of the country and their departure is deplored. I have heard of no Mormon recruits embarking at Queenstown. Such is the great stress laid in Ireland on chaste monogamy it is doubtful if ever the Mormon propagandist would be tolerated in the country.

The consul further remarks:

> All emigrants or intending emigrants are inspected and scrutinized by a medical officer appointed for the purpose, and I am informed that occasionally such intending emigrants are rejected on account of disease or for other causes, and forbidden to proceed on the voyage. Leprosy appears to have been common enough in Ireland some centuries ago, but I have heard of no cases in the country during my residence here. I have had no occasion for several years to report to the Department of State cases of contagions disease. Many emigrants go to the United States reasonably supplied with money. Four guineas is the usual rate of steerage passage to America, though I believe one or two lines take steerage passengers for 3 guineas. The proportion of prepaid passages must be very large—mainly for families. The younger grown members are first assisted to emigrate, and then, finally, the small children and parents. I have personally known two families which have thus emigrated, the emigration of the entire family covering a period of three or four years. The remittances in these cases were from one or more elder children who had gone out in the first place and who then assisted brothers and sisters somewhat younger to emigrate, and finally the parents, with small children.

I visited an emigrant agency in Cork and was struck with the variety of the inducements for emigration offered in the literature on the walls. Just before the sailing of steamers from the neighboring harbor of Queenstown, half an hour distant by rail, these agencies abound in suggestive pictures. A subagent enters one of the Cork agencies and remarks: "Here is a poor boy; he wants to go to St. Louis."

"What St. Louis?" asks the agent. "There are several St. Louises in America." The boy doesn't know, but finally it is discovered that it is probably St. Louis, in Missouri.

"The boy hasn't money enough to within 4 shillings," says the subagent. "Let him go." The boy is booked.

The emigrants are numerous who run thus close to the wind.

One of the subagents remarks:

> The British Government helps evicted peasants to get out of the country, wherever they want to go. Those who have gone to Buenos Ayres have been badly cheated. The Irish Nationalists use their influence to prevent the evicted from emigrating.

A tour in the interior of Ireland reveals social and industrial conditions which indicate that, although Ireland has lost nearly one-half its population by emigration, the improvement in the status of those remaining is not so marked as to give reason to believe that there can, for the present at least, be any diminution in the Irish transatlantic movement. Cabins without roofs, dismantled farms, and a frequent recurrence of other signs of social disorder, give no reason to hope for immediate improvement in the Irish status. At Tipperary the spectacle is an industrial siege and a social anomaly, valuable brick blocks

being closed and barred while a new town is being built of the same materials five minutes' walk to the west.

The upper windows of some of these "erected" blocks give evidence of frequent brickbats or of collision with other untoward accidents. Add to the social and industrial warfare the extreme poverty of the peasantry, accentuated by the potato blight, which this year has nearly cut off the habitual food supplies of the west of Ireland and greatly reduced the supply of usual food in the eastern half of the island where the potato disease has done less injury; that the number of assisted passages to the United States under the existing conditions in Ireland is likely considerably to increase in the next year is not unlikely, unless causes of a conservative nature not now visible shall begin to operate, in aspects not a few Ireland yet remains the saddest land in Europe, and a striking illustration of the mischiefs that result from carrying all one's eggs in one basket.

Without diversified industry, neither governed nor ruled, an almost purely agricultural people, and an agricultural people relying too exclusively on one crop, the potato, Ireland presents aspects of morbid suspicion, and of dislocation affecting all forms of life, which render a journey in country or town painful even to a superficial observer. A sort of guerilla warfare in many parts of the country attests the consequences that follow eviction, and the frequent evictions further influence the public mind. These generally occur at an early hour in the morning, those in a state of siege pouring hot water on the attacking officials, who finally end the contest by battering down the cottage door, unroofing it, and setting the household goods by the wayside, amid the jeers of the accumulating populace.

I found that in order to get any information on Irish emigration or related themes it was first necessary to dislodge from the mind of the native a strong force of distrust. As I happened to have letters from an Irish member of Parliament, I was enabled to open many mouths that otherwise might have been closed. Standing beside a chimney in the Irish country, the sole evidence that once a peasant's cottage stood hard by he remarked: "I advise you not to talk with everybody; but if you get hold of the right persons you can learn something." The atmosphere of these districts is sad, and the population sullen and gloomy. "Lend me half a crown an' I hope ye'l live till I pay ye" screamed a poor fellow from the hedge as our jaunting car bowled along the country side, Irish wit yet penetrating the dense gloom.

An observer of the emigrant class as they appear at Queenstown says:

> The emigrants as a rule are not ragged; they are able-bodied, fairly intelligent; I think the majority can read and write. They proceed largely to the interior of the United States, because there is offered a better chance for a home. Few return except for a visit. Those who come back, as a rule, are more dissatisfied with Ireland than they were prior to their emigration, I think a better class of Irish emigrate than ten years ago. Ninety per cent. of the Irish emigrants are "prepaids." Most of them

know where they are going and have friends to meet them on the other side. The worst lot of Irish emigrants that ever left this country were assisted to Buenos Ayres about two years ago, and they had a lot of distress. Some persons here think that emigrants should be required to take out consular certificates backed by the certificate of the priest.

Of course Great Britain likes to run the Irish out of Ireland to ease up the Irish question. A few years ago assisted Irish were shipped by the wholesale, but now there is more caution. Poor law guardians, it is said, sometimes forward children of tender years from workhouses in Ireland to convents in the United States. On the occasion of a strike in Dublin some time ago, trade unions helped many strikers to emigrate. At the time of the bakers' strike in Cork, some of the bakers were driven to the workhouse and were taken from there by the trade union, as I am told, and forwarded to the United States; but of course such men could not be rated as paupers, and 95 per cent. of Irish emigrants are farmers. I know of cases where American employers have prepaid passages to the United States on behalf of friends in the service of such employers in America—the employer running his risk of reimbursement in the labor of the emigrant thus assisted. I know of no syndicates in Ireland for the prepayment of passages, but agents enlarge a good deal on the glories of America.

In 1883 British workhouses were emptied on the United States quite extensively, but now not so. Even in Government assisted emigration many who had money imposed upon Government, and I think not over 10 per cent. of this Government assistance consisted of pauper emigration, but largely of those who were in temporary distress.

The emigrant agents in Queenstown generally are publicans running grog shops with lodgings attached. They go up to Cork to attend to their customers just before sailing of ship. Some of them I found communicative, but the wife of one of their class uproariously intercepted an interview, evidently suspecting that her husband was parting with information that menaced the business.

MORMON EMIGRATION.

The European rallying point for Mormon emigration is in Liverpool. In that city the Mormons have a chapel, eleven elders, and a large lodginghouse for converts. They also have a printing house where tracts and the Mormon bible, in several languages, are said to be printed. They send their elders from Liverpool to the south of England and into Wales and Scandinavian countries, where evangelizing centers are maintained, some of them permanent. They work quite exclusively in the country and village districts.

A Liverpool gentleman, who for years has had opportunity to observe the facts, says :

> They formerly directed their attention to securing pretty girls as converts. I have never seen among emigrants so many handsome girls as a few years ago joined the Utah movement from Europe through Liverpool, but since the legislation in the United States against polygamy a great change has occurred. Fewer young women are now being conducted from this side by the Mormon elders, but the Mormons are now taking families to America. They are quietly brought to the Liverpool lodging-house from the Continent or from Wales and carefully guarded from outsiders so that nobody can get at them. Their headquarters here are at Islington.
>
> How do they work? Well it is somewhat after this manner: They hold protracted meetings in the various country places, and when they have won hopeful converts in any number they form social centers, get contributions from the neighborhood, and when a convert wants to go to the promised land he is assisted to move to Utah. The converts, however, go in conducted groups, under strict surveillance, as already intimated. It seems to me that this Mormon emigration is in violation of the spirit of your contract-labor law, but perhaps it is an evasion that can not be reached. The people who go to Utah talk about "going to Canaan," and I know of some who were not very soundly converted to Mormonism, but who have taken this course to secure a cheap journey to the United States, abandoning the Mormons shortly after arriving in your country.
>
> These Mormon emigrants I should not call an undesirable class of people. They are from poor farming communities, and take this as a last chance for economic improvement rather than as the sure route to the kingdom of Heaven. They handle money very parsimoniously; indeed they have less money to spend here in Islington than they did a few years ago. They send out more emissaries at present into Wales than into any other country. The rank and file go out to America in the steerage, but the elders go first or second cabin.

In order to get at these Mormon emigrants more definitely I took a ship of the Guion Line (which the Mormon emigration seems to prefer). The ship of the Guion Line referred to was the *Wyoming*, having on board one hundred and twenty Scandinavian converts to Mormonism

beside a smaller number, probably of other nationalities, under the charge of several elders who sat at the tables in the first cabin, sailing from Liverpool to New York about the middle of August, 1890. My journey ended at Queenstown, but there was opportunity to observe and converse, although not of the most unobstructed kind, for every attempt at conversation with the elect was carefully watched by the elders, jealous for the spiritual validity of their flock. In several cases the converts were warned to keep their mouths shut, and attempted interviews intercepted or partial interviews interrupted, but enough vessels were found to be leaky to distill some interesting clews.

One of the Mormons encountered on the foredeck amid a collection of ragged Jews, on whom the light according to Brigham Young had not yet dawned, said:

> For seven years I have been in the Scandinavian work, holding meetings and converting people to the true faith. We shall have another company of converts coming to Utah by Liverpool next month (September), but that probably will be the last party for the year. We are bringing over about 700 converts from Europe each year.
>
> I was born in Norway, but for the last seven years, as I said, I have been in Norway, before that in Utah. The Bible says "the people of God shall suffer persecution," and I expect it. The United States Government is not alone in this persecution. We live in an atheistic and wicked age. I think "the last days" predicted by the prophet are nigh. As I read the Scriptures, that is the way it looks just now.

The sentence was left incomplete and probably never will be finished. One of the elders from the first cabin had caught us in the act; he beckoned to the Scandinavian to come to him. I had all I wanted. The story of Mormon propagandism in Europe is told. The substance of it is that polygamy is in decline, and that hardly one shipload of Mormon converts per year is the present fruit of Mormon evangelism in Europe.

THE JEWS IN EUROPE AND IN THE UNITED STATES.

The attempt to propagate race antagonisms in the United States has been most successful in those sections of our country where schoolhouses were scarce, illiteracy most pronounced, and where the dominant race was more prejudiced against honest toil. The remedy for prejudice against a race is mutual improvement in the intellect as well as the restoration of normal power to the heart. There have been attempts to import to this country the European intolerance of the Hebrew, but these attempts have not been successful. There is abroad in this country an ineradicable determination to take men for what they are and to give every citizen fair play.

If a certain Jew is a better man than a certain Gentile he has the benefit of his superior personality. Jacob or Esau, Isaiah or John, Saul or Paul, we give the modern Jew the fair chance that we give the He-

brew of the other dispensations. But on the continent of Europe this is not the case. Germany and Austria are driving the persecuted Jews, who are fleeing from Russia, from their frontiers, and this unhappy population is necessarily driven to the sea. In every ship now crossing the North Sea these refugees may be found. England is deeply exercised because she is getting the largest contingent. The latest word is that Russia affirms that she has adopted no new policy; but there are unmistakable signs that the Czar means ultimately to employ all the force there is in the anti-semitic laws of 1882.

If the Hebrews, who have so long been the scapegoats of religious and social fanaticism, are expelled from Russia even by the slower process now meditated, the total irruption of European paupers on Great Britain, and finally to a very large extent, on the United States, will be none the smaller.

To understand the situation of the Jews in Russia we must reflect a moment on the history of the Jews in that country. It should be said that the policy of Russia always has been to Russianize, and that means a good deal, even to orthodoxy. Of course, the Jewish rabbi resisted all Russian attempts to touch the distinctive traits of Judaism. But the Jews are a progressive people, despite rabbinical conservatism.

The school of Mendelsohn and the splendid personal influence of Sir Moses Montefiore in Russia were beginning to show fruit in a certain adaptation of Jewish thought to Russian control, a receptivity at which the frigid Russian Government began a little to thaw. Yet the old restrictions were unrepealed though suffered to fall into desuetude. All Russia was by no means open to the Jews for residence, but Jewish colonies settling in cities hitherto prohibited were tolerated or winked at. Beside every station of a newly constructed railway groups of three Jewish families were suffered to reside. At the university Jews were educated and learned to speak the Russian language. But the Jews were not suffered in any public position. A servant of the State no Jew could be, no matter how able, how learned, how wise and good. The sacrifices of the Jews in Russia met neither social nor political sanction; they were tolerated, and that coldly. Hence poverty and despondency in the Jewish race in Russia were intensified.

When the nihilist agitation broke out there were in the university young Jews burning with indignation at the injustice imposed on their race. Some of them naturally became nihilists. The race has for ages been dreaming of a political kingdom of God. That these idealists, hungry for progress as well as short of the bread that perishes, should be carried away by a quick sense of injustice and hereditary visions, is not a grave accusation. At once the Russian Government soliloquized: If giving the Jews some opportunity of knowledge and a slight taste of equality, turns them into nihilists, what would not be the disaster of further extension of Jewish autonomy?

Such is the background of the panicky movement of the Jewish Rus-

sians now in progress. I reiterate that diplomacy exercised upon Russia, rather than repression exercised at Castle Garden, in my judgment, is the true foil of this alarming irruption of pauper immigrants. The resuscitated edicts against the semitic population of Russia may at any moment be made sweeping by the interpretations of the bureaucracy.

In the present year (remarks a Russian Jew) the officials have terribly aggravated the severity of the laws by including many hundreds of small townships in the category of rural villages and expelling the Jews therefrom. Tens of thousands of Jewish homes have already been broken up. No Jew can own a farm or land, and thus every Jewish landed proprietor will be reduced to beggary, while to Jewish agricultural laborers there is no other recourse than an exodus to the sea which no longer miraculously divides to give them riddance of the modern Pharaoh. Hitherto Jews have been allowed to reside in but sixteen provinces, but by special grace Jews of the merchant class were suffered to live in commercial centers where they had long been established. But the anti-semitic movement of 1890 peremptorily expels from their homes in the sixteen 'Gaberania' many thousands of families, artisans, and workers, as well as traders. Jews are prohibited from mining industry and from all educational advantages as well as from becoming engineers or lawyers or army surgeons. The policy of Russia is extermination of the Hebrews in Russia—enforced pauperization—and if the execution of these despotic edicts is now and then less severe, the ultimate result will be the same.

The Israelitish Alliances in Berlin, Paris, London, and other cities, are doing a noble work in assisting their persecuted countrymen, many of whom are going to Brazil and Algeria, as well as to England and the United States.

In the chief cities of Europe there are benevolent Jewish societies for the aid of needy people of that race, both in the journey from place to place, from port to port, and to assist them in times of destitution. The Jewish Board of Guardians for the relief of the Jewish poor in London, and "the Poor Jews' Shelter," issue annual reports which are of value, as showing the tendencies and extent of pauper emigration. In 1889 the Jewish Board of Guardians in London relieved 445 natives of London; 1,197 foreigners resided in London seven years and upwards, and 1,328 foreigners resident less than seven years; in all, 2,980. In 1888 there were 3,513 cases of Jewish want relieved by the same guardians, the decrease in 1889 being most marked in regard to foreigners resident in England less than seven years. This decrease also is in Russians and Poles who have been swarming in menacing numbers in the east end of London. In "removing" poor emigrants from London it is stated that Jewish benevolence expended $3,170 in 1889, 252 persons having been helped "onwards" and 402 having been helped homewards.

CONTAGIOUS DISEASES.

The alarming spread of leprosy under the operation of timidity and cruelty in earlier ages in the orient and in the middle ages in Europe reveals the close connection there is between philanthropy and individual as well as national welfare, as one compares those results and their causes with the fact that under the laws of pity and benevolence applied with scientific wisdom leprosy in the two last centuries has been almost extinguished from the civilized world. It is true there are yet a few lepers in Europe, particularly in Norway, where by philanthropic science the number has been reduced from 3,000 to probably less than 1,000 within the memory of physicians who first began scientifically to treat the leper in Norway about thirty-five years ago. It is not yet settled that leprosy is contagious but it is treated as though it were contagious, and observation of the spread of many diseases formerly supposed to be wholly hereditary, shows that there is a power in semi-contagion as malign as in diseases well understood to be contagious.

On the continent of North America leprosy exists in New Brunswick but in the lazaretto at Tracadie it is declining—only 20 patients being reported there. In the Sandwich Islands, probably, leprosy is now more menacing than in any part of the northern hemisphere; but the movements of the past year are a new assurance that its decrease even there is certain.

Of all forms of plagues which menace the United States, we shall continue to have more to fear from cholera than from all others combined. Evidences are not wanting that the westward emigration of cholera, which began in 1888, continuing in 1889 and in 1890, may be renewed in 1891.

All things, accursed as well as blessed, seem to come out of the sunrise, only to seek the sunset, and the history of epidemics shows that cholera is no exception. Whether its entrance into Europe in the summer of 1890 was epidemic or pandemic, we know how prodigious are the efforts required to prevent the bacillus from leaping over seas as well as continents, in the fleets of oceanic caravans which follow "the ship of the desert." Hardly had La Grippe felled her first Russian victim when that Amazon among the bacilli got full grip of Yankees in the new world. I have already indicated certain precautions that may wisely be inaugurated without unnecessary delay against the movement of cholera to America in 1891. Especially disinfection of rags, whether in the hold of the ship or on the backs of emigrants, would seem to be a precaution which ought to be insisted on before ships from Europe are allowed to land, either cargoes or emigrants, at such times as the present.

The rapidity and ease of locomotion in the modern world are an added source of peril because the oriental occasions of the generation of pestilence are as active as ever in the midst of European commercial energy in the Orient. For example, the Hindoo and the Mohammedan are as devoted to their sacred shrines as ever, and their pilgrimages have quite the same commercial as well as religious popularity that they possessed centuries ago; while beside them are the great fleets of Indo-European commerce, hastened by steam through the Red Sea and the Suez Canal. As soon as the religious ceremonies at Mecca are concluded, there follows a vast fair, and for weeks all Mecca is busy loading and unloading caravans for the interior, and Jeddah is thronged with shipping.

Many pilgrims welcome death in Mecca as an answered prayer, the crowning desire of every believer's life. It is but few days by steam from Jeddah to Naples where all nations meet. The rags of the Old World easily find the New World in a week; the rags of the Orient find the Occident in half a month. It is evident that a little carelessness in 1891 may prove a costly luxury.

REGULATION OF IMMIGRATION.

Scattered hints, suggestions from various sources have been given in the foregoing pages concerning the regulation of immigration. It is now proper to sum them all if it be possible. In general, it may be said, the regulation of immigration already in force in the United States could well be supplemented by the regulation of emigration through our consular officers in Europe. It would seem that the best way to reach the immigrant is to reach him before he has come into the immigrant condition—even before he has touched the ship that is pointing toward these shores. Many plans have been suggested to effect this result.

One suggestion is this: That the intending emigrant be required to give notice to the nearest consular office of his intention to emigrate, upon which our consular officials shall institute inquiries regarding his fitness for American life, his character especially. If the inquiry is satisfactory, the consul shall issue certificates in triplicate, one to be retained by the office issuing it, one to be given to the emigrant, and the third forwarded to the collector of the port where the immigrant will disembark, none being allowed to land without a certificate. This plan obviously would be cumbersome, expensive, and must retard emigration as a whole, which perhaps would even commend it to some.

The proposition to exclude those coming on prepaid tickets (if not evaded, as it easily could be) would exclude about half of our present emigration, and my observation in the emigrant lodging-houses of

Europe tends to strengthen the impression that if such an exclusion were practicable it would not improve the quality of the emigrants, as but a very small part of that poverty is voluntary or due to the fault of the impoverished.

Another suggestion is the imposition of a head-tax of $1 or more on every immigrant. The 50 cents head-tax now paid by the steam-ship companies probably has a better basis in reason than the attempt to further burden those whose backs are already breaking. Some of our consuls in Europe, however, favor the proposition for a head-tax.

A modification of the certificate plan, proposed by one of our consuls in Germany, is to require the emigrant to present the proof of his moral fitness for American citizenship, thus relieving the consuls from the endless labor of independent investigation, except in suspected cases. Under this plan the intending emigrant would present to the consul a certificate under the seal and signature of the local authorities nearest his residence that he is sound in health and in mind, physically able to earn a living; that he has sufficient means to support himself and family until he can obtain employment; that his character for honesty, industry, and obedience to law is good; that he emigrates voluntarily and is not assisted; and is not under contract to perform labor in America.

Mr. George L. Catlin, our consul at Zürich, proposed to the Congressional Committee on Immigration a scheme of consular supervision of emigration which "seems perfectly practicable for a small country like Switzerland; and with the help of this law and the active good will of the Italian authorities, it might be made to work well in Italy." Mr. Catlin's plan is in substance the following:

(1) Every person intending to emigrate to the United States must declare his intention at least three months beforehand to the nearest United States consul; bringing with him an official certificate from the mayor or other officer of his town, showing him to be a person of good character and standing in the community.

(2) The applicant's declaration of intention—specifying domicile, occupation, names of parents, whether married or single, whether ever sentenced for crime, etc.—is to be made in triplicate.

(3) The consul makes inquiries and if the replies are not satisfactory refuses to authenticate the applicant's declaration.

(4) If satisfactory the consul authenticates, keeps one copy, returns one to the emigrant, and sends one to the United States Treasury or custom-house. The emigrant's permit serves as his permit for landing.

Consul-General Schuyler says:

Most of this information would be furnished, according to the Italian law, by the contract with the emigration agent. What remaining information is desirable could probably be easily obtained if our Government were to enter into a diplomatic agreement with Italy for this purpose. The regulations which are required by the Italian law, and which must be made in order to carry it out, could easily be so worded as to compel the communal authorities to indorse on the emigrant's passport or application all the information which we should need.

In the general conclusions which I have reached from European observation our consul in Gothenburg is concurrent. In reply to inquries propounded in July, 1890, Mr. Man writes as follows:

Relative to the examination of emigrants, for the purpose of weeding out such as are unwished for, I think it would be most effective to have restrictive measures applied in the country of the emigrant's origin. One reason is that any obstacle in the way of an unworthy emigrant undoubtedly would have more effect in the country where he resided before emigrating to America and while deliberating that move, when a slight thing might affect his decision, than after he had left his own country and traveled thousands of miles to a strange one.

The idea that I believe to be feasible would be to require the intending emigrant to file with a consular officer, on suitable blanks prepared for the purpose, a declaration of his intention to emigrate to the United States, containing name, age, occupation, parish of his registration, and also that he had never been in a jail or poorhouse, together with such other data as might be deemed appropriate, with a notice to the effect that he would have to take an oath to the matter contained therein, before the consular officer, in order to obtain a consular certificate; this to be filed a certain time before emigration, say three months. At the end of this time for the intending emigrant to be obliged to appear personally before the consular officer and swear to the contents of the aforesaid declaration, and such other matter as might be deemed pertinent. Upon his complying with these conditions satisfactorily to be furnished with a certificate giving him a prima facie right to land in the United States.

This I believe would have considerable effect in lessening the number of undesirable emigrants, although, of course, it could not be made infallible, as at the large emigrating centers it would be impossible for a consular officer to examine, with any degree of thoroughness, all emigrants, but the very fact of being subjected to these formalities would have a deterring influence upon the classes we do not want, while not interfering to any extent with those we do.

The same objections liable to be met with in this subject are often raised to the consular certification of invoices, viz, that such a number, representing such a variety of merchandise, can not be thoroughly examined by any consular officer, however expert; but no one conversant with such matters doubts for a moment that consular supervision has saved and is saving our Government millions of dollars, the fact alone of being obliged to sign a declaration as to the value, etc., of merchandise acting as a restraint upon undervaluation.

Regarding the emigrating class, most of which belong to the lower ranks of life, any official formality in the countries which they come from, and particularly the act of taking an oath, is regarded with such a feeling of inherent respect that it would undoubtedly exercise a restraining influence upon objectionable classes.

It is impossible confidently to predict the future of the Russian and Polish movement, but if the social pressure in Russia continues to increase there will arise a yet graver question concerning pauper emigration. It is a fact that already certain Russian provinces are almost depopulated of the peasantry. The hardships of the Huguenots in their epoch of persecution are in no small degree repeated to-day in the bitter experience of the Jewish race.

The chronic outcry against the foreigner breaks out in cycles in all nations. He was a stranger and they took him in, and in England it is raised in some unofficial quarters very loudly to-day against the Jews,

but not enough to modify the public policy, although the competition of Jewish labor in East London has invited the "sweating process," and very considerably endangered Gentile bread and butter in that previously somewhat impoverished section of London. At the Eritte Gun Works, in Germany, a threatened strike was avoided this year by the directors resolving to employ no further foreign labor. But the Pacific invasion of the foreigner has been the most extensive in Switzerland of any country in Europe. There are now settled in Switzerland 238,313 foreigners. That is to say, 10 per cent. of the settled population of Switzerland are not Swiss. In the city of Basle 34 per cent. of the population are foreigners; in Geneva, 38 per cent. Switzerland enjoys the foreigner who comes to board and lodge, but the foreigner who comes to stay and compete is less welcome.

There is so much regulation in this world that fails to regulate, that those most conversant with the laws of inertia and gravitation in the world of population as a rule are most conservative in the application of legal restrictions. A preliminary study of human nature, as well as of social conditions, is needful to understand the scientific relation of the incoming millions to the millions already citizens. The movement to keep the hereditary pauper and the criminal or the ex-criminal classes out of the land is too obviously a movement required for self-preservation. It is probable the present laws, already of some service, are capable of yet further improvement in this regard. The exclusion of contract laborers is rendered difficult by the ease with which the disingenuous contractor can change the place and yet keep the pain.

The number of the objectionable classes evoked by European civilization is enormous. In England and Wales alone there are nearly a million paupers and criminals—35,000 *habitual criminals* being reported at large in that small territory alone. Statistics almost equally menacing might be adduced from other parts of Europe, although on the Continent the statistics of political offenders are in some cases so confused with those of criminal offenses that the figures are a less definitive revelation of the status. Especially is this true of Russia.

It is true that where immigrants most swarm pauperism is most prevalent. Nearly half the pauper population of Massachusetts is of foreign birth. In New York the same proportion prevails. Yet there would be an enormous increase in the foreign-born pauper list in the United States but for the fact that heads of families are the advance guard who precede the family to prepare the way for independent support. Since 1883 about 1,000 paupers, contract laborers, and other classes whom our laws forbid have annually been returned to Europe by the ships which brought them.

Mr. John Jarrett, consul of the United States in Birmingham, under date of August 21, 1890, writes as follows concerning this subject:

> Since I have been here I have been quietly investigating the subject, but thus far I have been unable to discover any movement in which the Government of this coun-

try is interested directly or indirectly, for the purpose of assisting persons emigrating to the United States.

There are, however, beyond a question several agencies in this country which are engaged in this work. The chief of these was, and I think is still at 7 Cheapside, London. These do their business by advertising vacancies in America for clerks, printers, and mechanics. Large numbers call at these offices, and make engagements through these agencies, and thus get to the United States.

I have been very much impressed with the fact that the greater portion of persons leaving this country for the United States, at least two-thirds of the various classes of laborers are assisted to get out there. The low wages paid provide no opportunities whereby they may get the means of going out there on their own resources. From whence then do these persons get this help? Several, no doubt, receive passes from their friends who are already in the United States. If some means could be adopted by which we could know how many passes are forwarded from our country—for nearly all the work people in our country, when they send for their friends, do so by passes, *i. e.*, prepaid passages—having an idea of this number, it strikes me, the task of assisted emigration from this side would be much simplified.

Who shall have the tramp, the idler, the criminal, the dynamiter, the dangerous classes, is now the momentous question. But another question more momentous is this—What country shall have the honor of preventing these classes? What country shall, through the instincts of justice imbedded in law, minimize those conditions of production and of reproduction which breed human vermin? This, which is the profoundest of studies in sociology, is for that reason the profoundest subject for the attention of parliamentary bodies and of governments in an epoch when a constantly increasing number of political questions are also sociological.

As a rule those countries which are producing the largest crops of thistles in the industrial and social fields are doing the least work in exterminating and in preventing the multiplication of nuisances which are in the air and which, flying across the seas, defying national frontiers, involve alike in present dilemma both those nations which are promoting injustice and those that are in quest of equity. At present, it may be said, most nations are more exercised in dumping their paupers and criminals on their neighbors than in bringing moral and intellectual solvents to the causes which are behind social disorder, the unjust distribution of wealth and pauperism, and crime preventable by social readjustment and legislative reform. The problem is complicated by the haste of neighborhoods to be rid of moral and industrial lepers, who, are treated pretty much as physical lepers were treated in the Middle Ages.

The first thought of those concerned in the West End scandals in London, was to send the microbes to the United States, as the evidence adduced in the case revealed. But England is more sinned against than sinning. Of the 100,000 paupers in London, I am sure an enormous proportion have been swept out of the back doors of continental Europe. But brooms do not disinfect. The modern Hercules does not cleanse the Augean stable by sweeping the offal into his neighbor's lawn. Last year the London Thieves' Mission "sent abroad" 184 jail birds—ex

convicts, whom it is desired to start in life under happier auspices—a humanitarian enterprise worthy all praise, especially if pains is taken to reproduce this composite picture in some other world than the New World. But there are evidences that not a few ex-convicts find their way to the United States.

I do not believe, however, that any European Government participates directly in this movement. There are few fields, however, in which selfish benevolence is working more mischief than in the deportation of objectionable contingents of population. A true internationalism must make important strides before the moral bacilli shall be rendered harmless by inoculation at home rather than by exportation abroad. The remedy for the industrial evils which are a cause of undesirable population involves personal self-denial and a degree of absolute fraternity, which are harder to embody than to admire. The exportation of incompetents furnishes an easy substitute for the slower enterprise of removing such causes as lie at other doors than at the door of the incompetent himself.

Should the immigration of 1890 exceed that of 1889, as is now probable, we have to contemplate certain new proportions, an increase in the transoceanic journey of the undesirable southern races and also of the comparatively undesirable races of northern-central Europe—I say undesirable, but perhaps it were justice to say less desirable. But it does not seem to me that even these races are undesirable absolutely, but only such factors thereof as form an hereditary line of paupers, and in my judgment these factors are much smaller than is commonly supposed. The Irish movement declined and the German movement increased in the last decade, but there are causes slowly operating to reverse these conditions, although causes now unforeseen render prophecy precarious.

If the rising ethnic factors are Teutonic as well as Latin, we ought not to be apprehensive of the general result. As a rule the forces of the human instinct are safer than the artifices of meddlesomeness.

What we want, perhaps one may be permitted to assume, is historical investigation of social development and the close examination of existing phenomena in race movements as the basis of legislation. As a recent English economist has well said:

> Much more might be done with our existing social machinery if those who guide it will but seek to understand of what it is easily capable.

The cautious extension of the functions of the state is the lesson of contemporary interference, especially as seen in Germany.

Where most races mingle there is most power. We all are emigrants either of some generation or of other degeneration. Foreigners helped us to American independence. An assimilative power is the modern instance in favor of unhindered immigration. Though we have been at work fusing instead of confusing races, but for a few generations—having paid the price of servile labor by civil war—we have reached a degree of race-harmony that in Europe many centuries have failed to

secure. There is more harmony between the Northern and Southern States than there is between England and Ireland, and the jealousy of Prussia on the part of the smaller and southern German states reproduces the dogmas of State Rights among the Teutons in Fatherland. A state whose chief aim is to prevent revolution will cripple evolution.

The lesson for the United States, it would seem, is to steer between the extremes of let-nothing-alone and of let-everything alone. Is it not true that the nation most pronounced in *laissez faire* is already showing symptoms of excessive haste in the opposite direction in certain phases of its industrial and internal life?

It is a great mistake to confound temporary or local phases of human character with human nature. We must have faith in the wonderful pliability of the human mind. The world, especially the New World, will produce men and women of different type from ourselves, of different type from any existing European type, and our strongest assurance of an evolution in the type lies in immigration. The waves of foreign prejudice which occasionaily roll through our country covet hasty, sweeping, and illy digested legislation to restrict or restrain immigration. The country is to be congratulated that Congressional legislation continues to recognize the value of a good foreigner to the United States.

LABOR AND IMMIGRATION.

The industrial results of immigration often are misconceived just as the industrial results of new inventions often are misinterpreted. It does not do to view results from the immediate vicinity and time. When immigration flows into a country employers may compete less keenly for labor because there is more labor; but another result is the expansion of plant, the increase of consumption, and a larger aggregate share of labor out of the wages and profit fund. As you open the land, you increase the country's wealth, and eventually wages must be improved in that degree. No country more strikingly than the United States proves the fact that wages depend on the efficiency of work more than on any other single cause. The fact is that the consequent increased production in all trades increase the purchasing power of all, so that in the absence of other causes, like those of dishonesty, wild speculation, and gambling, the result is increased consumption.

It is astonishing to see how rapidly Italians of the new generation become meat eaters in America who in Italy lived on the sweet pods left over by the prodigal son and on the pork of a yet farther land.

American working men are alert to see the apparent inconsistency of protection to American industry which protects what the worker produces but invites new European millions free to compete with him; but many of these observers overlook the fact that Nature herself protects the man not only in the respects already adduced, but in virtue of the in-

trinsic expense and difficulty of moving man; for economists agree that of all "commodities" (not to use the word derogatively) man is the hardest to move. Not until hunger and hardship have become extreme will men forsake all that they have to seek a land to whose institutions, manners, customs, and language they are alien.

Nationality is more intense in France, Germany, and in Italy than in the United States. There is a tax of nature on the emigrant which he can not evade. The rupture of home, neighborhood, family ties, and all that, expressed in homesickness, is a tremendous head tax which Divine Providence imposes on the hearts of emigrants. An hour in the steerage of a crowded ocean steamship just pushing out into the Atlantic ferry from Hamburg or Naples will easily satisfy the skeptic who fancies that God has forgotten to protect or that man has neglected to regard the wages factor of the profit and wages fund of American labor. And it should not be forgotten that while young men in the Eastern States of our country easily emigrate in harmony with Horace Greeley's overworked advice, the young men and families of Europe find the sea a greater barrier to a new country than we in the United States find corresponding distances by land; for this is all our country, while in the European case it is not theirs. It is harder for a European peasant to raise $50 to get himself into the New World than it is for an American youth to raise five to ten times that sum. The fact that in the midst of enormous immigration wages in the United States continue to be as they have so long been, 40 to 60 per cent. higher than in Europe, is a practical answer to him who thinks American labor is not the best protected of the protected "commodities," if you choose to give labor that unscientific classification.

THE NIGHTMARE OF ANARCHY.

The law is, if you want an evil, fear it. Timidity and fear of open debate are the intellectual bacilli of anarchy. A government which fears its toilers, turns them into loiterers. An anarchist is developed out of a Socialist by iron and blood unmixed with justice in the government. Just as German Socialists were beginning to develop into anarchists, the young Kaiser, with right insight, interpreted the popular judgment as recorded in the elections for the Reichstag, and turned his attention to the labor question. The French have 15,000 foreigners, chiefly in Paris, of whom they they want to be rid, and we have a small contingent of similar quality in New York and Chicago. Our policy is the right one—to give them free course to "sweat with their mouths," but to show no quarter to assassins and murderers who endeavor to pose as political idealists.

Every great city has its centers of danger on which social revolutionists to-day are operating. John Burns to-day is listening to the ravings of Louise Michel in the Socialist headquarters in London; but

London smiles and her stormings are not dignified by martyrdom. In St. Petersburg and in all Russia the governed hold the governors in a state of siege. And to add to the grotesqueness of the situation the European Governments fill the streets of their cities with armed soldiers with extra ammunition on the day on which the working men celebrate the holiday of labor. The worst anarchists are women.

To remove the causes which are the apologetics of Socialism before they have become active is far wiser for our Republic than to attempt any aggrandizing of Socialism in America by suppressing its freedom either of speech or of movement. The attempt to weed the anarchic contingent out of the steerage or second cabin of ships sailing from Europe to ports in the United States is nowhere proposed. The half-educated foreigner, whose little learning is a more dangerous thing in this period than in any preceding transition epoch of history, will make his informed ignorance dangerous chiefly to himself, in the absence of Bismarckian or Russian repression. The social and political condition of London on Labor Day or anarchists' Sunday compared with that of St. Petersburg, Berlin, Paris, Milan, or Rome, is a complete justification of the Anglo-Saxon policy of freedom of emigration.

The Czar's indigestion, the Pope's allocution, the Kaiser's rescript, the strikes in Rome, the mutinies of unskilled labor in London and in Southampton, the poor harvests of Kansas or of Russia and Italy and Germany and even of India, the socialist propaganda, a war and rumor of war, the movement of an army corps on the Russian frontier or on the Italian border, the vote of the Reichstag on the budget or of the Congress of the United States on silver, all these and unmentioned multitudes of other causes promote or diminish emigration. The solidarity of the race is the irresistible tendency of an age of steam and printing presses. It is the wisdom of business in national as in individual life to direct its progress in harmony with forces that can not be extinguished and which may be correlated with movements progressive or retrogressive, according as wisdom or unwisdom regulates or dislocates the world of legislation, society, and industry.

We may deplore, as the Germans do, the chronic discontent, the illy-regulated unrest of modern populations; especially suburban and rural populations; but Jeremiah is not the prophet we require. Ruskin sneers at the materialistic tendencies, as do most of those who live among pure ideas; but deeper than the surface, which is restless, are the pure circulations which this restlessness is constantly aërating. "Our two objects in life," says Ruskin, "are, whatever we have, to get more; and wherever we are, to go somewhere else." But Ruskin overlooks the fact that the ideal society which his sneer would project upon the world is oriental. Better an hour of Boston, New York, or Chicago than a cycle of Cathay, absolutely contented, and never seeing any horizon but that within which one's cradle was rocked. Seven hundred persons a day leave Great Britain in quest of fortune. One hardly needs pre-

dict what Great Britain would become under the operation of that oriental and untraveled contentment which is the halo of Ruskin's social dreams.

In whatever respects the close of the nineteenth century is an improvement over the close of the eighteenth century (not to go back a century or two earlier), we must look for the controlling motives of all the political, social, and industrial and moral improvement to the inherent unrest and ambition of western European races. That at Plymouth Rock was initial of which our present annual average of half a million pilgrims is a sequence. Queenstown, Liverpool, Glasgow, Antwerp, Bremen, Hamburg, Havre, Marseilles, Genoa, Naples are the fruit of seeds planted at Plymouth and Leyden. In place of Parson Robinson we have Carl Marx; in place of Roger Williams we have Lasalle. But the sense of justice, liberty, political and social progress to-day is as closely allied to instinctive ambitious and discontents on the side of material progress as it was when the Pilgrims planted their first patch of Indian corn in the perilous soil of Samoset, who, by the way, was the first American reformer of whom American history speaks.

As within a month after the epidemic of influenza started in Russia in the close of the year 1889, that strange epidemic had crossed the continents and the seas, counting its victims by the thousand and the hundred thousand from the Neva to the Mississippi, from the Tiber to the Thames, so in the social and industrial life what at first appears to be sporadic becomes epidemic on electric wings. There is force, such as never began to be acknowledged in the eighteenth century, to the cosmopolitan tendencies—"a blow to one is a blow to all." Bane and blessing belt the globe. The cable is repaired almost as soon as it is broken. Russia's poverty produces Whitechapel in London, and the publican and sinner on Italian estates evokes Mulberry street in New York. Even "the dear old devil" is not quite what he used to be. Change is not only imminent, but immanent. It is not that we are sorry that we are here, but that we *are* here. And Ruskin is not our prophet. He only controls nature who guides her forces and conforms to her laws.

To overlook popular opinion and the public mind has been the chief fault of economic science and the chief characteristic of tentative legislation; but the method which is successful in physical science fails in economic and moral science. The forgotten factor of the new era of solid, logical legislation is the solidarity of the race, the modern expression of social, political, and economic progress. "The belief that a change ought to occur and will occur tends to make it occur." Socialism itself is the effect, not the cause, of modern discontent. The African who came to us against his will never was an immigrant. We are to blame for his being here. The Italian who comes to us of his

own free will is an immigrant, and if anybody is to blame, he is to blame. The question now is whether the forces of current discontent are not Providentially moving to free and acclimated settlements of European races amid agriculture hitherto largely under the manipulation of an abused and hence unwilling equatorial race.

There have been many solutions of the Southern question which failed to solve it, but the solvent factor surely is time, and it may be time working on material stranded on the Appenines in the fall of the eastern empire of Constantine. It is only that nation which is dominated by blood and iron which need fear iron in the blood. Only that government which is based on justice and administered in equity will surely be exempt from the nightmare of anarchy.

THE FOREIGNER IN AMERICAN CITIES.

The prodigious growth of American cities is the intellectual as well as industrial phenomenon of the last decade of the nineteenth century. In cities we distance all civilization, both eastern and western. We have, or ere the twentieth century shall have a dozen cities having a million and upwards of population. Of the thousands of emigrants who land daily in New York, it is probable that 33 per cent. become permanent dwellers in our cities. On a railway emigrant train from New York a canvass was made, showing among the passengers the following: Americans, Germans, Dutch, Italians, Scotch, English, French, and Chinese of whom upwards of 50 per cent. were going to various cities.

American cities, both the provincial and small and the commercial and large, to-day are in a certain sense foreign cities. Every language under the sun is spoken in them, and there is "a quarter" where each nationality predominates. This is also true of Berlin, London, Paris, and other European cities; but in American cities this characteristic is universal, obtrusive and hence more pregnant with industrial, social, and political consequences. Cities are more than depots of trade. Cities generate intellectual, and the country generates moral force. It is as necessary to have centers of thought and of distribution as to have areas of ethical power and production. The man who made the New World a fact of consciousness instead of a dream of the imagination, was born in a city, but the founders of New England civilization were rustics. Columbus was an Italian, born in Genoa, but Brewster and Bradford and the whole body of founders of the civilization of the New World were born and bred in the country. Washington was a gentleman, but a country-gentleman, and Lincoln moved out of a cabin into the White House.

Moral forces in politics are country bred, as a rule. Cities promote political progress, so far as that progress depends on the intellectual forces; but cities dwarf enthusiasm, self-sacrifice, reverence and chastity, while they promote the charitable and industrial virtues. The city is less social than the country; in the country an Irishman and a Yankee owning adjacent farms necessarily become sociable. In cities dwellers on different flats of the same house are unknown to each other. The country hastens the amalgamation of races; the city tends to luxury and physical decay. The conditions that are favorable to intellectual growth usually are unfavorable to moral development. Cities repress crime but encourage vice. The country supplies fewer safeguards against crime but it discourages vice.

It has been well said that the morals of men are more governed by their pursuits than by their opinions. Cities are the bane and the blessing of the State. A purely agricultural country would be stagnant. The city and the country are respectively the antidote for the bane, the one of the other. For the safety of States there must be healthful coördination of urban and rural life, a proportion, point and counterpoint in rhythm of population. Are not some of the clews to a better proportion in American life, to a diminished alien congestion in cities, furnished in the suburban movements of Italians and in the tendency to garden farming and other small agricultural enterprise illustrated by the Swedes and indeed to a considerable extent by the Irish, Scotch, and other immigrants who need informing and direction and who have been redeemed from cities where they were not needed, to the country where they were needed, by the enterprise of individuals who, instead of issuing jeremiads over the decline of American rural life and over the idle lands in States old and new, have started immigration to the land and opened up new agricultural colonies to make the city more indispensable by making the country more productive?

Cities are to-day as they were in the middle ages, the asylums of feudalized workingmen seeking better wages. The free cities of Germany and Holland saved industrial freedom. The function of cities continues in substance, though the form may change. By extending the suburban influences, the standard of living and supply, ease of communication, cheap transportation, the parcel post, postal savings banks, daily mails, libraries, schools, and other facilities, the city and country may be brought into better touch and rural life aggrandized.

One of the closest English students of emigration gives me the following views:

I would be cautious about interfering with the liberty of any individual who is not under the ban of the common law. If you want to prevent the free movement of populations seeking to better their conditions, you must go outside the common law. But I think Russia has no business to unload her undesirable population either upon Great Britain or upon the United States. I think it is possible that this question may become grave enough for diplomatic protest.

As to the congestion of population in cities, I believe it is less than is assumed.

The middleman exists because he is wanted. The Italian who sells matches, or grinds scissors on the streets would not be there did not his patronage prove that he is a public convenience to the extent of a public willingness to be taxed to keep him there. The crowds of vendors on the streets are more a convenience than a nuisance.

I think the present tendency to avoid the country and to flock to the city will continue as a dominant bias for the reason under the present conditions of life, the tendency is that fewer and fewer persons are needed to raise the same quantities of food, owing to better methods of farming and improved machinery. The moment there is a rush to land, that moment bread and meat become cheaper, and farming is now on the decline because it pays less than the average of other employments. Yet I know that were a general advance in wages to occur, so as to increase the purchasing power of the masses, there would be a vast increase of consumption of food as well as of other products. This would be especially true of meat and dairy products.

The prime reason why people seek the city is human nature. People find in the city happier conditions of life as a whole, the amusements which they need, the libraries and schools which they want, the chances for getting on in the world. I do not look regretfully on modern municipal life. I believe the evils of city life will gradually be corrected by time, and I am wary of legislative interference, while I agree that the evils of immigration might become so great in England as to call for legislative interference, but I am in no hurry. Data for legislative interference are yet wanting. I would not legislate to keep a bare-footed, ragged, or even drunken immigrant from landing in England. Not that I might not perceive certain evil results, but that I am very chary of restricting the absolute freedom of English soil. I can perceive, however, that this Jewish movement into England might become such a menace to our country as to render interference necessary, but I do not see that such a time has yet arrived. There is small doubt that in this matter Russia is already violating the comity of nations.

It is a common mistake to suppose there is in Great Britain a considerable army of unemployed. But, the fact is, only 1 per cent. of our population is idle in cycles when business is good, and not over 5 per cent. in periods when business is poor. The tendency to cities is a sign of evolving social tendencies. The advantages of civilization are wanted, and large cities prove the good results of the increase of product from the land as compared with the labor-power expended. The multiplication and increased population of cities is a declaration that there is an increase of human leisure for the mind of man.

The principle at issue in the matter of regulating emigration is this: How many encroachments on personal liberty are advisable or permissable under the principle of the greatest good to the greatest number? Shall all die for one? Certainly not. Shall one die for all? If so, how many of the minority must we sacrifice for the majority?

The newspapers of England during the past season have been speaking of the 320,000 of annual gain in the United Kingdom in spite of colonization and emigration, and in the issues in which their congestion of population is spoken of paragraphs like the following may be found.

Kentish farmers are commenting somewhat anxiously on the scarcity of labor. The crops must soon be got in, but there is no sign this year of the usual swarm of casual laborers seeking work in the harvest fields. A disengaged laborer promises to be as scarce in the country as an unoccupied lodging-house at the seaside.

In other words, despite the density of population in Great Britain, there is the same complaint which is made in Germany, only less emphatic, of the difficulty not only of holding the old workers, but of securing new agricultural laborers. English students of this phenome-

non argue that this difficulty arises not out of any perversity in human nature, but because the average condition of the wage-workers, even in the most congested districts of English cities, is better than that of the agricultural employé. And this statement, no doubt, has much of the force of truth, because hours are longer, wages smaller, and the intellectual opportunities and physical relaxations are fewer in the country than in the city.

The hardships of metropolitan life in Europe are, however, considerable. In summer nights thousands of homeless persons make their beds in the parks, on the seats of Victoria Embankment, and in the dark nooks in and around Covent Garden. Every recess on Waterloo and Blackfriar bridges is an involuntary bedroom under the canopy of fog and drizzle, despite the enormous energies of benevolent institutions and private charities. The special investigations of the parliamentary committee on the emigration and immigration of foreigners states that in 1889 there was a check on the immigration of destitute foreigners to London; but if I am not misinterpreting the statistics of 1890, the influx of the past year has been much larger than for the year preceding. Of the foreigners who enter England and Scotland at ports north of London, all but a mere handful pass on to the United States, while of those who come to London from the Continent a large majority remain in the country, choosing London especially. Into the Thames, in all sorts of craft, the continental races swarm, and a night in the east end of London is the most striking illustration of the evils of pauper immigration which the world affords.

It is estimated by a recent writer that in 1888 less than half our population were descendants of the original white colonists. Our American cities are singularly cosmopolitan in this respect, more foreign in population than many that are foreign in location. A day in New York, Philadelphia, Pittsburg, or even Holyoke or Lowell, is a day in Naples, Genoa, Paris, Berlin, St. Petersburg, Copenhagen, London, or even Jerusalem or Canton. One may girdle the globe without Puck. The Ghetto at Rome has disappeared, but you may find it in the Hebrew quarters, not only of London and Manchester, but also of New York and Chicago. The majority of immigrants land and stay a while at least in the Middle States, but in the end many of them find the West—the vague continental spaces yet open for the poor and cast down. But certain races have an ineradicable preference for towns.

One who has studied the Irish peasantry and observed their love of land in Ireland, wonders at their dislike of the American farm. The Irish in the United States are a metropolitan race. The Germans are fond of cities, but they take to the land more kindly than the Irish peasantry. The English choose New England, but its manufacturing cities. Only the Scandinavians have a decided bias at the very outset for the hill farms of New England or the fields of Minnesota. There are manufacturing cities from Maine to Illinois whose native population

is not 25 per cent. of its foreign population. The French Canadians and the Irish form upwards of 50 per cent. of the population of several manufacturing cities in Maine. The Yankee, at the present rate of change and assimilation, will soon have to put himself in a glass case to preserve his identity.

Fall River, Mass., has but 17 per cent. of native-born citizens, and Holyoke, in the same State, only 16 per cent. Many New England cities are constituted 45 per cent. Irish; others, 30 per cent. Scotch and English; others, yet, 60 per cent. Italian. Boston, Lowell, Lawrence are no less foreign than New York, Pittsburg, and Buffalo. There is no doubt that the problem of municipal government is greatly complicated by the presence of this indigestible illiteracy and of this provincial and alien mass which more than once has shaped not only metropolitan, but State and national government. It is only by strenuous loyalty to civic education and the common school that results yet more serious can be avoided. It should be considered, however, that the intellectual discipline of new population proceeds much more rapidly in city than it could proceed in the country, and that the problem in cities is as much the preservation or upbuilding of civic virtue as the decline and fall of illiteracy.

Of our foreign population about 30 per cent. is now illiterate—the ratio being increased especially by the Italian movement; but attention is again called to the fact that compulsory education in nearly all of Europe will soon materially improve the statistics of emigration in regard to illiteracy.

The American farmer is now our native-born citizen *par excellence*. While our cities are controlled, as a rule, by foreigners, or, if not controlled, overpopulated by foreigners, of the probable million of farmers in our country only about 100,000 are foreign. While foreigners form at least half of our manufacturing population, they form but 10 per cent. of our agricultural population.

THE EMIGRATING WOMAN.

While some of the new States, Territories, and communities of the United States are advertising in Europe to pay a premium for women emigrants and putting a special tax on bachelors and bestowing special privileges on benedicts, family life in cities is declining, divorces are multiplying, and club life is organizing as a substitute for family life. On the continent of Europe woman is the overlooked factor of political life as well as of intellectual and social progress. The increasing proportion of young women in the steerage of emigrant ships is due to causes more involved and numerous than the motives of male emigration. In the steerage of a steam-ship about to sail to New York from Glasgow I saw at least a hundred young women, nine-tenths of whom

were going to the less populous parts of the United States, some to the farm-houses of friends in our distant Territories.

In treating of French emigration by the way of Canada, striking peculiarities of the race movements were noted. The English who come to this country via the English colonies number not a few. There is an incipient movement from Australia to the United States; but the movement from the Dominion of Canada, and especially from New Brunswick, Nova Scotia, and Prince Edward Island is quite large. Last year 38,989 of the "flitting bluenoses" entered the United States from points east of Vanceboro', while but 20,369 returned. These figures do not include the large incoming by sea. Thousands of girls seeking employment as house servants enter the United States from the far northeast of our continent.

In four months of last year about 3,500 persons emigrated from Prince Edward Island to the United States. Of course this emigration is far more transient than the transatlantic movement, as is shown by the almost imperceptible number of children coming in from the provinces; but the fact is that during the busy season of the year an enormous amount of industrial power has come from that source into New England. Add to this the contingent of English-speaking immigrants that come via Island Pond, and the total figures rise to nearly 50,000 English, or, including French-Canadian, to nearly 70,000 all told. The percentage of women in this emigrant list is only less than the percentage in the Irish movement. A phenomenon of the present emigratory movement is the increase of the swarm of young women to the country which is singularly adapted by its sense of fair play to woman to give her an independent career.

COLONIZATION AND EMIGRATION.

Statistics of emigration taken alone do not convey with adequate force the enormous presumption which exists in the minds of European masses in favor of the institution and industrial and social and religious advantages of the United States. I have already indicated the tremendous activity of German official and semi-official circles in the promotion of colonization, especially in Africa, and the feeble stream which this agency succeeds in forcing uphill. But if the Germans are sometimes fruitlessly active in their zeal for colonization the English are scientific, tireless, systematic, thoroughly organized, as long practice and prodigious success in colonization naturally would imply.

The literature of current and projected English colonization is enormous. The mother country is flooded with posters, circulars, prospectuses, pamphlets, volumes whose object is to convince the English-speaking races of the home country that both self-interest and patriotism, the welfare of the wage-worker and of the manufacturer, of the

shopkeeper and of the jobber lies in encouraging the industrial exploitation of the colonies. Quick and cheap passages to Australia, New Zealand, Manitoba, special favors to settlers and other enticements are laid before the people. Yet in spite of all the Canaan of the mother country is the child that cut the apron strings only a little over a century ago. And the especially noteworthy feature of the English colonial policy is the somewhat obtrusive spirit of independence in the colonies, which, in some quarters, is interpreted as anti-English, both from the point of view of nationality and of trade.

The English in England say that every pipeful of their tobacco is now helping to pay for land that is as much advantage to the trade of other lands as to itself. The fact is that in our generation colonization from a purely selfish point of view is exasperating in the ratio that it is successful. In a purely humanitarian aspect the picture is more pleasing; but people in a singularly commercial age and spirit object to any scheme that, even at the bowl of a pipe, is exclusively confined to showing that it is more blessed to give than to receive. With the rubbish of other lands pouring into an already congested labor market, Great Britain to-day is uneasy over the increasing difficulties and menacing questions of colonization, and not a few of her people are crying out for restrictions on pauper immigration and for a better occupation of the land of the kingdom itself. It would be an interesting phenomenon of changing opinion if England should begin with a protective system where America stops.

But the great lesson which English emigration statistics and colonization histories has for the United States is this, the practically unlimited potential of the home trade of the United States under the beneficent expansions of agriculture and manufactures, country and city, production and consumption, resultant from thoroughly colonizing and populating the home farm. Under a homogeneous federation a union of hands becomes a union of hearts. To populate first and then to federate is difficult, as England perceives at arms' lengths in several senses. Federation in this country preceded population. This is the most powerful of reasons for the great stream of emigration now coming to us. At the same time this is one of the most urgent of reasons for encouraging it. *En passant* one might add that Russia is to-day opposing British dominion in Africa, favoring German colonization there as a counterpoise to that of Great Britain in the Orient, and because a German outlet in Africa means an easy vent for superfluous population that swarms into the western Russian provinces to the detriment and danger of the Czar.

Civilization in the year 1890 has been very active on paper, that is, the agitation in its favor was never more pronounced in Europe. Prince Hohenlohe is at the head of a German syndicate for the purchase of immense tracts of land in the State of Chihuahua in Mexico, to be colonized by Germans. Chinese colonists are said to be preparing to occupy

a million and a half of acres purchased on the Isthmus of Tehuantepec. Austrian capitalists are making investigations in America with speculations in view, in some cases, and with colonization as a means of margins, in view in other cases. The efforts of the German foreign office to divert German emigration toward German colonization are elsewhere treated of.

GENERAL REMARKS.

The ferment of emigration accounts for great popular movements. The exodus led by Moses was fathered not only by ethical but by physical causes. Hunger was the eleventh commandment that got currency before the tenth. Abram was a foreigner developing the agricultural resources of a country much as the rangers of western cattle ranches are now doing, pastoral forerunners of an agricultural evolution. The colonies of Phœnicia and of Greece exemplify the rise of new societies out of domestic emigration, as clearly as the Dutch in Manhattan, the English in Massachusetts, or the French in New Orleans. When 6,000 hungry and gigantic Scandinavians with their families swore never to forsake each other and moved south, "God brought them to a vale in the Alps"—and the germs of Swiss nationality were planted amid self-denial as profound as that of the Plymouth colony. The emigrations of Germanic races reconstructed Europe.

The earlier movements of peoples were abetted by religious persecution, reënforcing the motive of hunger, but the revocation of the edict of Nantes showed how religious persecution fertilizes industrial evolution. The first traders were travelers. When the Queen of Sheba came to Solomon, she brought propitiatory presents. Her visit served her much as that of the peripatetic Italian to the United States serves him to-day. That oriental Yankee woman went back to the Dark Continent wiser than she was before, and she got more than she gave. Emigration which begins to travel and passes from transient into permanent characteristics, gives rise to commerce, to geography, to the expansion of all forms of human life. The Queen of Sheba left locusts and wild honey on becoming an emigrant just as the Italian gives up coarse bread and curd on becoming an American.

The United States is taking from Europe its best industrial power but is giving back to Europe an enlarged commerce. The exports from Naples to the United States have enormously increased since the Latin race began to swarm in America. It is the blessing of all races and all nations that Man is an emigrating animal. The provincial intellect which expends itself in hating foreigners is in the thick skull of prejudice, not under the large hat of social, political, industrial, or moral progress. The history of Spain is rich in suggestiveness. Despite the printing-press, the railway, and modern science, Spain is depopulated.

A splendid country that God made, man has spoilt. The prosperity of modern states is in the ratio of their toleration of Babel. By this test one may measure the great progress of the United Kingdom and of the United States as well as the stagnation of Russia, and the dilemmas of Germany. The nation that welcomes good men and women from afar, is rich because intelligent toilers add to national wealth and there is no limit yet in sight to the productiveness of land scientifically cultivated. Emigration is a barometer of two social conditions—it tells of the pressure of the social atmosphere in the country whence it comes and in the country whither it goes.

Races rise in virtue of physique, knowledge, and fidelity. The Dutch made the sands of Holland, discovered in the bed of the sea, into a fertile country, the most influential in the history of modern civilization, of any land and people, according to area and population. They founded our greatest American city as a holiday while slave labor was turning gardens into a wilderness in the Southern States of America. It was the Dutch emigrant that laid the foundations of English manufacturing and commercial thrift. Such is the power of uprightness, mutual confidence, technical skill, and a good body, in the rudest of climate, that makes at once for work and health.

Judged by this standard what is the industrial value of an Italian who is coming, in spite of us if not because of us, as compared with that of the African who came in his own despite and whom many, whose hereditary ideas forced the issue on America, now heartily wish to be rid of? Employers of African labor often reply for that matter. The employers of Italian labor, as elsewhere cited, speak highly of the fidelity and physique if they can not of the knowledge of such samples of Latin industry as have come to these shores.

By the same test it is likely that Americans would more highly esteem the German than the French, while unquestionably highest in rank of fidelity if not highest in rank of knowledge, the Scotch and English emigrant probably would be placed. And also in their favor is their community of language and of origin. The Celtic stock probably assimilates as readily as the Teutonic. The Irish immigrant of the second and third generations loses his Celtic individuality in a degree. If in thrift and knowledge the Irish are inferior to the English, Scotch, and Germans, their influence on the domestic virtues in the United States, on family chastity and unity in particular, has been most favorable.

There is no doubt that socially, industrially, physically, and even morally, each of the four great emigrating races are doing this country, as a whole, a great service. In other words the evils of emigration under the existing restrictions are small as compared with the blessings which immigration confers on the body, mind, heart, and future career of Americans. The process of natural selection never had such full swing among human population.

The emigration statistics of the United States published since the year 1890 opened, have amazed European governments. The fact that since 1820 Europe has sent upwards of 15,000,000 of people to the United States to develop the resources of the Republic, is impressive especially in Great Britain which has lost 6,000,000, in Germany which has lost upwards of 4,500,000, and in Ireland which has lost 3,500,000. To the continental races the spread of the English tongue is not the least significant consequence of this immense movement of races.

Since the opening of the present century English has advanced from 21,000,000 to 125,000,000 speakers—that is, from 13 to 31 per cent.—largely through emigration to the United States. English is now spoken by nearly twice as many people as any of the other tongues of Europe and its relative growth shows no signs of diminution. English has preëmpted the North American continent, where there are to-day twice as many speakers of English as there are of French in Europe. The English language also occupies Australia, Great Britain and Ireland, while in South Africa and India it menaces all other tongues. In fact, English is now the speech of the world of travel and of trade.

The feature of immigration most to be emphasized, is not its evils, which are few compared with its blessings which no man can number, blessings singularly such as are needed in a new country which yet remains so largely in a state of nature for the want of industrial power Apart from the inclement season, which is the prohibitory act of nature on out-of-door operations whether in internal improvement or in agriculture, unskilled labor in the United States is yet in great request. The scarcity is notable in the busy seasons of the year, while at all seasons of the year the kitchen, the laundry, and the house in general call in vain for cooks, scrubbers, and chambermaids.

The nation which wants the foreigner least, to-day is least wanted of steam, invention, and social and political progress. The rise of prejudice is the fall of industry.

The movements of races in the dawn of history were politico-economic; the corresponding movements at the close of the nineteenth century are economic-political—that is, the economic factor is now foremost. We have seen the operation of the political factor, however, in the Semitic exodus from Russia and the politico-economic in the Irish movement; but the vaster movements, like those of the Teutonic, Latin, and English races, are predominantly economic.

We need, accordingly, to keep as predominantly in mind that the necessary result of these facts is that the United States, as a rule, gets the hardiest and most select of the masses of European populations.

As a rule, among existing conditions, the most enterprising yet constitute the great body of emigration. We must not wonder, then, at the prominence which the word "enterprise" enjoys in the American industrial vocabulary. Emigration to-day as clearly as ever deprives a country of industrial power, and immigration adds to the wealth of the

land that enjoys it. I advisedly say enjoys it; for the deeper the race antagonisms within a country, the more surely will blessing turn to bane. To encourage immigration and education together is to insure prosperity.

There are about 600,000,000 of square yards in the earth's surface; yet one statistician figures that at the present rate of increase of population in England there would not be standing room on the globe in A. D 3,000; but England is the world's way station, and there are evidences that nature cares for her own by the limitation of families and by the almost boundless expansion of the productive capacity of land. Dear bread means less wedlock, while rise in incomes means more families if not larger families. Stock quotations and honeymoons are coördinated.

But capital and labor are not of infinite power. They can not enlarge the world's area, though they can prodigiously multiply its productive power. The endowment of air and sun may be slightly modified by man, but their aggregate is beyond man's reach. There are said to be 1,450,000,000 of people in the world of whom probably less than 10 per cent. are in the New World.

While, then, the globe easily could support ten times the population it ever has had, yet, of course, there is a limit to production under the law of diminishing return. After population had reached a certain density, a time might come when additional outlay would not raise a proportionately increased amount of food, and while we never have had a period in history when means of possible subsistence at all lagged behind population, it is easily conceivable that the decline of war, the improvement of sanitation and science, as well as sound ethics applied to social life, might end in hunger. Fortunately, the easiest way to solve such problems is not to solve them, for they are not likely to become urgent for thirty centuries yet to come, and no doubt the patriarchs of that next Pentateuch will be able to build their own bridges and look out for Pharaohs not now in sight, and to manage their own Red Seas not now a menace. It is enough to say, that on this side of the sea, and at the close of the nineteenth century, a craze against foreign immigration would be irrational, suicidal, anti-American, anti-republican; but all this may be true amid the enforcement of obligations imposed by a first principle of self preservation. We want in our veins more good blood, while we must beware of poison which might involve all in common disaster.

APPENDIX.

GERMAN OFFICIAL VIEWS ON COLONIAL AND ON AMERICAN IMMIGRATION.

The following is translated from a paper recently established by the German foreign office in the interests of colonial emigration, and is here reproduced as showing something of the sentiment now prevailing in Germany relative to emigration and colonization:

The difficult problem of German colonial politics is no nearer solution. Why does Government not govern German emigration from the standpoint of the people so the people might think that the Government ought to care for its colonies and increase opportunities of trade, and watch for the coöperation for this department of emigration? But one must consider that the home opportunities are not absorbed. Private parties at home are fond of Government aid. We need, however, fuller statistics about the callings of emigrants. We also want the reasons of emigration, the goal, and home of emigrants. Out of these facts we could find causes of emigration. Now the gate and door stand open to every objection. We need to know what becomes of our people and how they fare when they emigrate. Many emigrants look very unfairly on their future in Germany, and deceive themselves, and long for strange homes, and underrate the value of their old position in Fatherland. Statistics ought to make our people more content by showing the frequency of failures abroad. We need to remake agents' affairs, and through good colonization will the realm be able to correct the status. In general, capital and work together, are strong in transatlantic enterprise, because there the Government, growing and protecting, stands aside. The need and utility of colonization are clear. The now-existing German colonization companies, however, fail for want of capital. In South America interest is from 20 to 30 per cent., and German capital is easily diverted. In no undertaking is gold a more ethical force than when it coöperates to call sound colonization into life.

The cause of German emigration is relative overpopulation. Either improved conditions of existence or greater economy at home is necessary. The growing knowledge, ability, and capital of Fatherland should not be lost to Fatherland, and when these go hence they should not be separated in interest from Fatherland. Our emigrants go to America, Australia, and other countries. The competition in the industrial districts, the pressure in the higher callings, our one-sided culture, and the smallness of our territory are elements to be taken into account. According to Dr. Fabri, it is the struggle for existence which occasions mass emigration, and emigration is strongest where wages are lowest, and where the wages of the rural population are such that the workers can not create a home of their own. Knowledge and ability seek expression. The extension of our territory might insure for our people a normal development. Emigration is the natural result of the increase of population in a country whose land and industry offer for this increase unsatisfactory opportunity and reward. It is like the overflow of a filled cistern. There is emigration voluntary and arbitrary, the necessary result of recent economic development. The continued overpopulation of European lands kindles a desire for the extension of domestic territory directly at the frontier, but there is a necessity of seeking this extension in

distant places. Besides, there is an anxiety of small proprietors that their children and relatives may not fall into the proletriæ.

German specialists agree that German emigration is an historical fact, and that it must be explained from history. In view of the equal growth of all callings and trades, the cry goes forth from all workers as well as from the landed proprietors and well-to-do callings. It is difficult for the wage-worker to get good wages on the one hand, while on the other hand the land-owner struggles to hold his own. A German company in Baltimore reports that it is amazing what masses of young educated men come here without knowledge of English, thinking that immediately they will have a good position on account of their knowledge. Their illusions are not realized. Some few succeed to good positions; others send home for passage money to return to Germany; others go to farms; and some turn to tramps.

Of Germans emigrating to the United States, all callings give their contingent, as is illustrated by the following statistics from the census. According to the census of 1880, Germans in the United States represented callings as follows:

Farmers	240,000	Liquor sellers	20,200	Glass makers	1,500
Land laborers	50,000	Traders	11,000	Gold and silver workers	3,000
Gardeners	88,000	Shoe drummers	1,700	Smiths	2,200
Small farmers	1,500	Tobacconists	2,600	———	4,400
Herdsmen	580	Clothing traders	3,000	Bat makers	1,300
Cattle raisers	400	Apothecaries	1,100	Workmen in iron and steel	9,000
———	7,000	Traders in small wares	6,000	Carvers	1,000
Restaurant keepers	1,200	Colonial ware traders	17,000	Machinists	8,000
Clergymen	4,200	Wine and spirit traders	3,200	Manufacturers	5,200
Servants	64,000	Grocers	38,000	Stone cutters	3,000
Eating house keepers	5,000	Real estate agents	600	Masons	1,200
Hotel landlords	4,000	A long list of hand work and miners		Dress makers	9,000
Laundry proprietors	5,000	Bakers	14,000	Millers	3,500
Lawyers	750	———	15,000	Painters and sculptors	10,000
Musicians	4,000	Bookbinders	1,100	Instrument makers	1,600
Officers	2,700	Beer brewers	10,000	Lead workers	800
Doctors	2,550	Shoemakers	28,000	Printers and lithographers	3,500
Beer gardens	2,400	Brick workers	3,000	Stone breakers	760
Teachers	4,500	Butchers	80,000	Saw mill workers	5,000
Agents	1,000	Contractors	600	Ship carpenters	600
Bankers	800	Cabinet makers	12,000	Soap makers	1,400
Book-keepers	3,200	Carpenters	30,000	Ship boiler makers	750
Clerks	17,500	Cigar makers	12,000	Men and women tailors	37,000
Drummers	1,600	Watch makers	1,700	Knife makers	1,500
Teamsters	13,000	Sweet bakers	2,700	Wheel makers	1,500
Railroad employés	10,000	Cooks	9,000	Turners	2,300
Interpreters	7,000	Cotton spinners	1,000	Wool spinners	3,500
Milk men	1,800	Manufacturing workers	3,000		
Railroad officials	2,700	Engineers and firemen	4,000		
Peddlers	3,100				
Sailors	2,100				
Small sellers, men and women	2,000				

Unfortunately the German Government has no survey of its own industrial population to be compared in value with this. To American statistics we are indebted for all the knowledge we have of the callings of emigrating Germans.

It is evident that in considering the subject of colonization we must look to all the

professions. A firm position in life is obviously better than an uncertain one. The pressure of overpopulation obviously is on all trades and callings, both official and private. There is a great pressure for life positions due to favorable conditions of men early in life. The German army has absorbed the influx of workers among the wealthy classes, but the learned officer and teacher wait very long for a position and yet longer for promotion. The higher aristocracy take the best places, and a lower official position pays little. Everywhere is dissatisfaction. How to provide for the surplus becomes very difficult, and the surplus population increases and the over-population is in all departments. So need and want follow. One must not overlook socialism. This tends to magnify the evils of society. It is easy to lay off the blame for the struggle for existence.

In New York cheap lodging-houses serve large numbers of needy young men with beds for 10 cents a night. Emigrants, penniless, repent too late of having emigrated and say, "I can't be worse off in the United States than I am in Germany. Why can't I succeed?"

So the emigrants stifle objections. But emigration to a strange land is far more difficult than it appears. Cultivated Germans, of whom you might expect better things, go the United States as well as others. The surgeon, officer, physician, economist, and spinner go, expecting to convert their knowledge into cash. The majority of these immigrants underrate the value of their places in Germany and overrate the value of places in the United States. In 1888 there emigrated from Germany to the United States 98,568 persons; from Bremen, 52,977; from Hamburg, 24,502. Eight and nine-tenths of this belonged to land and forest economy; other professions and trades, sixteen and seven-tenths; peasants and ——, 8 per cent.; unclassified, 16 per cent. Forty-two per cent. were members of families. The wage-workers and persons without callings show least. In the year 1888 probably 33,000 land-workers left Germany. From 1871 to 1880, inclusive, there emigrated to the United States 1,769,297 Germans. In this number there were not included many foreign ports, since to the United States, from 1871 to 1887, there went out of Germany 1,884,750 Germans. In this time Hanover, West Prussia, and Schleswig Holstein show most emigration. The land and forest lose an enormous contingent. For the evil of the emigration of our peasantry there is the remedy of keeping good the conditions of peasant life and giving satisfactory employment—making room for independence at home. If we want these persons to stay at home on a little we must make it as easy as we can for them. All who are not needed, the surplus, must emigrate. The expansive strength of our people will not be circumvented by law.

A satisfactory existence is not now assured in the Fatherland, hence the people thus affected must go elsewhere or the morbid tramp will frightfully increase. The state thus suffers badly from the loss of good citizens and steps should be taken for the increase of estate positions. Heath and moor cultivation in the east of Fatherland is increasing. Wrong relations exist between an increasing peasantry and a scarcity of land. High land rent prevents field farming and is a hindrance to the progress of the peasantry. Large estates are also a barrier. There is a pressure from all callings. Our territory of consumption is too small for our production, to say nothing of our ability to produce more.

From 1860 to 1871, if emigration had stood in direct relation to exportation the exportation from Germany would have been nine times as large as that of France. The exportations of England would have been from one-half to three-fourths greater than those from Germany, and yet the fact is they were really five and one-half times larger. Our most important problem is to convert into money our working strength in furthering colonization in strange lands in order that this productive strength may advance the consumption of agricultural products.

Professions and trades play a part in emigration as important as do land and forest. Beside overpopulation there are other causes of emigration. The chief motives of colonization have reference to four chief divisions of human life—family, property,

church, and State. All mass-appearances in history must be explained through the co-operation of the practical ideal. People doubt whether religion or belief has anything to do with emigration. The compulsory school, and the army, and State taxes and so on are among the causes which stimulate emigration from Fatherland. Socialistic and political dreams lead to emigration and form seductive enticements to the New World. They also lead those of healthier minds to be disgusted with Fatherland and hence to emigrate. In numerous cases emigrating Germans send money home for passage abroad, and Germans at home convert into money their own assets in order to emigrate. Through teaching and warning this should be overcome. We must have organic control and recognition of a free development.

First. German emigration is the expression of German affairs and ways in connection with German history and development.

Second. German emigration is caused in the main by overpopulation, whose surplus might be utilized by better distribution of lands and industry.

Third. German emigration is often due to self-deceit and false enticements. The home positions are underrated and the attractions of foreign lands are overestimated. Socialism helps this work. Every emigrant hopes for more independence. There is a want of organization in the German management of emigration. Since 1888 has transatlantic emigration existed and against all warning. In some cases it has been seen that the United States were ready to make it difficult for emigrants, and yet in spite of all efforts to divert the stream of emigration to the Latin races of South America, but a very small contingent now go to South America. Does Providence wish the best of our population to pour as emigrants into the United States? From 1871, not only Prussian and Suabian, but all districts have been drawn abroad carried on by the consciousness on the part of the emigrant that he was one of a great nation. From 1871 to 1888, inclusive, there emigrated out of Germany 1,769,297 persons. Of these there went to the United States 1,618,816. In the same time 4,780 emigrated to British North America, 33,443 to Brazil, 15,999 to other ports in South America, 16,841 to Australia, 4,047 to Africa, 108,000 to Asia. The American statistics are in fact even higher than the census of the United States would indicate, because many Germans go from England and other ports.

German immigration from 1871 to 1887 constituted over 28 per cent. of all immigration to the United States. In emigration the Germans are the strongest race. German emigration to the United States is exceeded by but 2 per cent. by the emigration of England, Ireland, and Scotland together. The immigration into the United States has already been given. From England and Wales in the same period it was 913,371; Ireland, 906,271; Sweden, 405,442; Italy, 346,706; Norway, 232,168; from the Eastern Empire, 211,174; Scotland, 187,121; Russia, exclusive of Finland, 154,864; France, 105,047.

Although the immigration statistics contain no explicit statement as to the part of the United States which is preferred by German immigrants, a picture of the distribution of the Germans in the United States may be obtained by a study of the census. The following figures give the distribution of Germans in America in the year 1880, but only in cases where more than ten thousand German immigrants have settled in a single State.

State.	Increase.	Decrease since 1870.	Entire population in general.	State.	Increase.	Decrease since 1870.	Entire population in general.
California	42, 532	12, 833	864, 694	Michigan	89, 085	24, 942	1, 636, 937
Connecticut ...	15, 627	3, 184	622, 700	Minnesota	66, 592	25, 228	780, 773
Illinois	235, 686	32, 036	3, 077, 871	Missouri	106, 806	68, 182	168, 380
Indiana.....	80, 756	2, 700	1, 978, 301	Nebraska	31, 125	20, 171	452, 402
Iowa	88, 268	22, 108	1, 624, 615	New Jersey ..	64, 935	10, 936	1, 131, 116
Kansas	28, 034	15, 260	996, 096	New York	355, 913	39, 031	5, 082, 871
Kentucky	30, 413	95	1, 648, 690	Ohio	192, 597	9, 708	3, 198, 062
Louisiana	17, 475	1, 437	939, 946	Pennsylvania .	168, 426	8, 280	4, 282, 891
Maryland	45, 481	1, 564	934, 943	Texas	35, 347	11, 371	1, 591, 749
Massachusetts.	16, 872	3, 802	1, 783, 083	Wisconsin	184, 328	22, 014	1, 315, 497

The above States have absorbed almost the entire immigration. They swallow up 96.5 per cent. of all immigrants born in Germany, and only 3.5 are left for all States and Territories not mentioned in the above figures. This fact, as well as the increase of Germans in the above States from 1870 to 1880, make it evident that the rule is that the children prefer to remain where they find already a vigorous branch of their countrymen has been planted. Single States in America must have a very prominent German character. For example, the immigrants born in Germany are 14 per cent. of the whole population of the State of Wisconsin; in Minnesota, 8.5 per cent.; in Illinois, 7.7 per cent.; in New York, 7 per cent.; in Nebraska, 6.9 per cent.; in Ohio, 6 per cent.; in New Jersey, 5.7 per cent.; in Iowa and Michigan, 5.4 per cent.; and in the rest of the States from 6.9 per cent. to 2.2 per cent. That in some of these States the German element must have been already for a long time very prominent becomes still more evident if we look at the population in these States as it existed in the middle of the century. Franztöher mentions as States which could become especially German, Ohio, Indiana, Illinois, Missouri, Iowa, Wisconsin, Michigan, and Upper Canada.

Further, Pennsylvania and a part of New York on the one side, and Texas on the other, would become the boundary line as far as the sea. The thickest of the German population would be between the waters of the Ohio and the Missouri, while north are the Yankee States, and south of these the old slave States.

According to the statistics of the port of Boston, in 1844 the number of Germans in the United States amounted to 4,888,632. On the contrary the entire population in the year mentioned was 18,980,000, from which, according to H. Löher, 3,250,000 slaves and colored persons should be deducted, leaving the number of whites 15,730,000. Therefore one-third of the white inhabitants of the United States consists of Germans. Löher considers these figures to be too high. By his reckoning, which is made with great knowledge of the relations concerned, the number of Germans in the year 1846 in the United States diminished to between one-fifth and one-fourth of the entire white population. In this juxtaposition only those inhabitants are considered as Germans who in the year 1846 still used the German language. Now there was about this time in these States, which in the last ten years have mainly absorbed the German immigration, an equally strong tendency to German emigration. Already in the year 1846 in some of these States the German inhabitants comprised about 40 per cent. of the entire population.

A CONSUL'S VIEWS OF EMIGRATION.

The following is a statement from our consul at Hamburg:

It so seldom occurs that emigrants apply at the consulates for emigrants' invoices that it can not be estimated as a circumstance producing a knowledge of the character and condition of the emigrants. The Consular Regulations do not require consuls to make an inspection of emigrants at the ports of embarkation, hence the consuls' information as to what classes emigrate, whether they are intelligent and able-bodied, or whether they intend to become citizens, must of course be very limited. My knowledge of the emigration from this port to the United States is restricted to such observations as are made on meeting them on the streets as they are passing on their way to ocean steamers.

Another fact noticeable is that 68 per cent. of the emigration by way of Hamburg is from other European and non-European countries, the emigrants merely passing through Hamburg, giving me no opportunity to asctertain whether they are going to the United States to become citizens or whether they are intelligent and able-bodied or not. Of the entire emigration to all countries by way of Hamburg 8 per cent. were farmers, 12½ per cent. artisans, 13¼ per cent. tradesmen, 32.68 per cent. laborers, 1⅓ per cent. other occupations, and 32.22 per cent. were persons without occupation.

"Efforts of persons to promote and stimulate German emigration must be secret

and clandestine. Such efforts could not be widespread and continuous without being discovered. Charitable and other associations intending to ameliorate the condition and assist struggling humanity may occasionally aid some person or persons to emigrate to the United States to improve their opportunities of making a living, but such action is kept within the bosom of the association and is not known even to the steam-ship company transporting them.

The methods adopted by the steam-ship companies to secure business and patronage of their lines are such as are calculated to induce their booking agents through cupidity to stimulate and encourage emigration of the people. The booking or steam-ship company's agents are licensed by the Government, and are required to file bonds to the amount of about $5,000. They are to show that they have a contract with one steam-ship company to transport such passengers as they may book. The laws controlling the actions of these agents are intended to promote the welfare of the emigrants, and protect them from frauds, misrepresentations, and from persuasions to emigrate.

The steam-ship company fixes a limit upon the amount they shall take from the passenger for his transportation. Out of this sum they are to remit to the steam-ship company a certain amount; the balance is returned as their commission, which is generally a liberal percentage of the sum received. These agents advertise largely in the newspapers. The steam-ship company receives from railroads, State immigration commissioners, and immigration societies printed matter descriptive of the country and often holding out glittering promises of great success to immigrants, and this is placed with the booking agents for distribution.

The indiscriminate distributing of this printed matter is, however, forbidden by the Government. The agents are permitted to place it alone with those who voluntarily inquire for it. As the steam-ship company and booking agents both depend upon the movement of the people for their pecuniary success, it is their interest to promote emigration, and doubtless more or less efforts are made by these agents to create a traffic of this nature. It is not within the scope of my knowledge to assert that these efforts are made through misrepresentation.

There are also a number of boarding-houses established in Hamburgh for the entertainment of emigrants; whether the proprietors of these houses make any efforts to stimulate a spirit of emigration, I am unable to state.

The steam-ship companies have also appointed agents in nearly all the towns in the United States to encourage, direct, and collect traffic for their lines. Not an insignificant portion of the money received from passenger traffic is paid by these agents for what is denominated "prepaid tickets."

I am informed by the pool agent in Hamburg of the English steam-ship companies that 25 per cent. of the emigration by way of Hamburg to the United States goes over on "prepaid tickets," that is, upon tickets purchased in the United States and sent to the emigrant in Europe.

I am also informed by the Hamburg American Packet Company that about 40 per cent. of all emigrants by their line travel on what is known as "prepaid tickets." These agents are allowed a very generous percentage on all tickets they sell. It is my impression that the great number of assisted emigrants who are thrown upon our shores receive their assistance from persons residing in the United States. The steam-ship companies have adopted only legitimate methods to secure business. It can scarcely be imagined that a steam-ship company can know the condition of the emigrants who go by their lines, nor can it know the character and class, except on their outward appearance.

The steam-ship company that receives from its agent in St. Paul, Minn., a remittance for the passage of a person residing in Hungary is not presumed to know whether the person whom it is to transport is a convict or a laborer under contract, nor is it reasonable to suppose the agents always know. A manufacturer or other person in the United States desiring labor, writes to Europe to know if he can obtain a certain

kind of labor, and upon receiving a favorable answer he goes to an agent, purchases tickets for certain persons, the agent remits the passage money and names to the steam-ship company and the tickets are sent to the persons. It is in this way that the laws of the United States forbidding the landing of contract laborers are so constantly violated. Unquestionably many of those who go by prepaid tickets are induced and assisted by members of their families or friends who have become firmly settled.

There is a large number of emigrants who go through Hamburg to the United States by the English and other lines of steam-ships, which is denominated in direct emigration. Statistics does not furnish what proportion of this emigration going to the United States have occupations or trades, but the emigration from Germany and other European and non-European countries which passes through Hamburg is classed in occupations as follows: Eight per cent. farmers, 12.5 per cent. artisans, 13.1 per cent. tradesmen, 32.68 laborers, and 32.22 per cent. without occupations.

From my knowledge of the character of German emigrants that have settled in the United States, the good largely predominate. Of course, where there is much light there must also be some shadow. The matter-of-fact modes of life in our country, the dire necessity of working for a livelihood, the non-consideration of their former position and social advantages by our people, and their dependence upon their own exertions put them upon their mettle, and the best characteristics of good citizenship are not unfrequently developed. When this is not the case they become chronic growlers, join the hands of the disaffected.

GERMAN OFFICIAL DATA.

The industrial and social data issued in monthly pamphlets by the Government authorities at Hamburg are models of their class, covering the products of export and import and the completest details obtainable concerning the movements of German emigration. I subjoin several sheets of statistics from these monthly pamphlets, giving more information of an exact statistical quality than is obtainable at any other source.

SELF-HELP EMIGRATION SOCIETIES.

Among the many documents supplied to callers gratis at the London emigration office in Westminster are the following:

SELF-HELP EMIGRATION SOCIETY,
4 Fleet Lane, Farringdon Street, London, E. C.

SIR OR MADAM: In reply to your inquiry as to what assistance this society can give, I send you a form which you should fill up and send to me, giving every particular therein asked for.

We send emigrants to Canada during the spring and summer up till the end of July. Persons who are going to homes provided for them by their friends, or to situations, can go at any time. The *first party* leaves London about the middle of April, and sails from Liverpool.

We can find places for hundreds of *good farm laborers and domestic servants*, and a reasonable number of good mechanics, such as carpenters, bricklayers, stone-cutters, and brickmakers. *Professional men, clerks, and shopmen are not wanted.*

Strong, healthy young men who are willing to take *rough work* on farms can be placed in situations without much difficulty.

Many who have paid all their own expenses have in previous years gone out under the auspices of this society in order to secure letters of introduction to our honorary correspondents.

It is important you should understand that this society can only assist with *small grants* those who show, either by the help of their friends or by their own exertions, that they are able to do something for themselves.

The personal character of each applicant is carefully investigated, and this society will not help those who are unlikely to make useful colonists.

The cost of reaching Canada is, for each adult, from London, via Liverpool, to Montreal, £4, including kit. Children between the ages of one and twelve years, half price. Infants under twelve months, 10*s*.

To this must be added the railway fare from Montreal to a suitable country center, say 10*s*. to 30*s*. each, more or less, according to distance.

The cost of passage to Australia is from £13 13*s*. to £16 16*s*.

Please return this form, giving full particulars, and especially stating whether you can raise the whole of your fare. The committee will then make an appointment for you to wait upon them, if they think your case is likely to be suitable, and if you live within a reasonable distance of London.

The office is open during the emigration season every day from 10 to 2, and on Mondays and Wednesdays from 6 to 8 p. m.

R. MACKAY, *Secretary.*

No. — .

Self-help Emigration Society, 4 Fleet Lane, Farringdon street, London, E. C.

APPLICATION FOR ASSISTANCE TO EMIGRATE.

	Memorandums by committee.
1. Name of applicant in full_____	
2. Age last birthday_____. Usual occupation_____	
3. Address in full_____	
4. If applicant has a family, state particulars below:	
Age of wife_____	
Her occupation before marriage_____	
Number of children_____	
5. Names and ages of children_____	
6. Applicant's place of birth_____	
7. Occupation until age of 21_____	
8. If now in regular employment, state employer's name and address and business .....} _____	
9. State present wages_____. How long in present situation?_____	
10. Has he friends in any colony?_____	
11. Name the colony he wishes to go to_____	
12. Has he ever lived out of the United Kingdom?_____	
13. What amount can he find towards cost of passage?_____	
14. What amount will friends find?_____	
15. * Names, addresses, and occupations of two references._____	
The foregoing statements are, to the best of my knowledge, perfectly true.	
Date_____	
Applicant's signature_____	
Should there be any willful misstatement in the form, the application will be at once rejected. If any further remarks are necessary, please write overleaf.	

* One of these must be a clergyman, minister of religion, or present or former employer.

BRITISH AND IRISH EMIGRATION.

The following tables have recently been issued by the British Government:

BALANCE OF EMIGRATION.

Balance of emigration, deducting total recorded immigration from total recorded emigration.

Years.	Emigration.	Immigration.	Net emigration.	Years.	Emigration.	Immigration.	Net emigration.
1870	256, 940	49, 157	207, 783	1880	332, 294	68, 316	263, 978
1871	252, 435	53, 827	198, 608	1881	392, 514	77, 105	315, 409
1872	295, 213	70, 181	225, 032	1882	413, 288	82, 804	330, 484
1873	310, 612	86, 416	224, 196	1883	397, 157	100, 503	296, 654
1874	241, 014	118, 129	122, 885	1884	303, 901	123, 466	180, 435
1875	173, 809	94, 228	79, 581	1885	264, 385	113, 549	150, 836
1876	138, 222	93, 557	44, 665	1886	330, 801	108, 879	221, 922
1877	119, 971	81, 848	38, 123	1887	396, 494	119, 013	277, 481
1878	147, 663	77, 951	69, 712	1888	398, 494	128, 879	269, 615
1879	217, 163	53, 973	163, 190	1889	342, 641	147, 398	195, 243

Balance of emigration of persons of British and Irish origin only, deducting recorded immigration from recorded emigration of such persons.

Years.	Emigration.	Immigration.	Net emigration.	
			Numbers.	Proportion per cent. of total population of United Kingdom.
1876	109, 469	71, 404	38, 065	0. 11
1877	95, 195	63, 890	31, 305	0. 09
1878	112, 902	54, 944	57, 958	0, 17
1879	164, 274	37, 936	126, 338	0. 37
1880	227, 542	47, 007	180, 535	0. 52
1881	243, 002	52, 707	190, 295	0. 54
1882	279, 366	54, 711	224, 655	0. 64
1883	320, 118	73, 804	246, 314	0 69
1884	242, 179	91, 356	150, 823	0. 42
1885	207, 644	85, 468	122, 176	0. 34
1886	232, 900	80, 018	152, 882	0. 42
1887	281, 487	85, 475	196, 012	0. 53
1888	279, 928	94, 133	185, 795	0. 50
1889	253, 795	103, 070	150, 725	0. 40

Destinations of excess of emigrants over immigrants, among persons of British and Irish origin only, in the undermentioned years.

Years.	Country of emigration and immigration.				Total.
	United States.	British North America.	Australasia.	All other places.	
1876	*143	2, 706	29, 617	5, 885	38, 065
1877	603	2, 033	25, 501	3, 168	31, 305
1878	20, 654	4, 448	32, 272	584	57, 958
1879	71, 758	14, 455	35, 992	4, 133	126, 338
1880	140, 052	16, 214	18, 274	5, 995	180, 535
1881	146, 323	18, 151	16, 805	9, 016	190, 295
1882	153, 435	34, 344	30, 418	6, 458	224, 655
1883	144, 870	37, 164	64, 420	*140	246, 314
1884	93, 814	22, 273	35, 943	*1, 207	150, 823
1885	80, 083	10, 517	31, 449	127	122, 176
1886	99, 801	17, 578	34, 096	1, 407	152, 882
1887	143, 183	25, 177	23, 925	3, 727	196, 012
1888	131, 955	26, 036	20, 740	7, 064	185, 795
1889	97, 379	19, 627	17, 856	15, 863	150, 725

* Excess of immigrants.

CANADIAN NORTHWEST.

FREE GRANTS TO SETTLERS.

Settlers can obtain free grants of land in the Canadian Northwest upon the following conditions, viz:

1. By making entry and within six months thereafter erecting a habitable house and commencing actual residence upon the land, and continuing to reside upon it for at least six months in each year for three years, and doing reasonable cultivation during that period.

2. By making entry for the land, cultivating it for three years, so that at the end of that period not less than 40 acres be under cultivation; residing for at least six months in each year during that time within a radius of 2 miles of the homestead; and erecting a house and residing in it upon the homestead for three months next preceding the application for patent.

3. By making entry and within six months from the date thereof commencing the cultivation of the homestead; breaking and preparing for crop within the first year not less than 5 acres; cropping the said 5 acres, and breaking and preparing for crop not less than 10 acres in addition; and erecting a habitable house before the expiration of the second year, and thereafter residing thereon at least six months in each year; and cultivating the land for three years next prior to the date of the application for patent.

The only charge for a homestead of 160 acres is the entrance fee of $10; in the case of forfeited pre-emptions, an additional fee of $5; and in case of canceled homesteads an additional inspection fee of $10. Settlers have the right to preëmpt the adjoining quarter-section of 160 acres, if available, and, within six months of completion of the homestead duties, may purchase the preëmption at the price of Government lands at the time of making the entry. On failure to complete such purchase, the preëmption may be opened for settlement on conditions stated in the thirty-sixth section of the Dominion lands act.

There are also numbers of circulars giving detailed and explicit information of the industrial opportunities, wages, cost of living of all parts of the Canadas, Australia, Australasia, and South Africa, with the minutest details for all trades and professions.

BRITISH AND IRISH EMIGRATION.

[From the London Telegraph.]

During the last thirty-two years, according to official returns, no fewer than 5,648,000 persons emigrated from the United Kingdom, of whom 60 per cent. went to the United States, and only 20 per cent. to Australia. How much Great Britain would have gained had the proportions been reversed, by the additional stimulus given to her trade and manufactures, it needs no argument to prove. The natural conclusion arrived at is that "the most urgently needed aid to Australian development is selected British and European populations, suitable for settlement on the land, and for raising productions for which there is a large demand in the colonies, the United Kingdom, and foreign countries." What these productions comprise is but imperfectly realized here as yet. Most Englishmen know that Australia has exported any quantity of wool, tallow, copper ore, gold, and wheat; but few know what that beneficent and yet varied climate and soil might do in the growth of sugar, cotton, fruit, and, above all, the vine. The expansion of the wine industry is referred to as illustrating the sources of wealth scarcely tapped as yet.

In Great Britain the consumption of Australian wine during the last ten months was 280,000 gallons; and experts from Bordeaux who have visited the colonies have

fully satisfied themselves of their superior capacity for growing high-class qualities. Details as to this and other products may be multiplied to any extent, but perhaps they are hardly needed. No one questions the natural resources of Australia, and few have permitted themselves any doubt as to these being rapidly developed. Nor will there be any disposition to traverse the arguments in favor of a much larger immigration and a more continuous expansion of agricultural industries. It is pointed out that there are markets—not of the mother country alone—prepared to absorb all the productions of Australian soil for generations to come; that the liquidation of international trade balances would thus be much facilitated and Australian credit strengthened in Europe; and that the solution of the imperial federation problem would be rendered easier. The benefits and advantages being clear enough, why, it will be asked, have not the necessary steps to secure them been long since taken by the Australians themselves? Immigration, we are told in reply, is systematically discouraged there because the working-class element predominates by means of its complete organization for political ends, and this element chooses to regard all imported labor with jealousy and distrust. The immigrant is looked at, not as one who increases the common fund of production and the consumption of articles produced, but simply as a competitor to be received and treated with coldness and jealousy in accordance with the exclusive motto of obstructives to colonial progress—"Australia for the Australians." In fact, the democracy of labor at the antipodes is like the similar organization at work in the United States, which would fain drive out Chinese and keep out Europeans, and is consistently protectionist all through, as it promises to be ere long in England.

GOOD NEWS FOR EMIGRANTS.

[From an English provincial newspaper.]

Most of the emigration failures in the colonies and America have arisen, firstly, through men thinking there are better opportunities abroad than at home for the lazy and the dissolute; and, secondly, from men going to the wrong places, and to the right places at the wrong times. Skilled labor backed by honest industry will get along anywhere; but it is of the last importance to select for its operations settlements where there is an unusual opening for work and enterprise.

The Emigrants' Information Office, 31 Broadway, Westminster, supplies this class of information to all comers, and issues a quarterly paper of intelligence which should be thoroughly circulated. Philanthropical people and institutions devoted to the welfare of the masses would do well to lend a hand to such a practical work as this. The circular contains prospective notes of great importance. During the past quarter there has been much improvement in the labor market of New Zealand and South Australia; and the prospects in New South Wales and western Australia turned out to be far more encouraging to the emigrant than the colonial papers led us to believe. Cape Colony had experienced a comparative scarcity of mechanics, and there is still an opening for workmen connected with the building trades. The Argentine Republic offers, it is believed, solid attractions to European emigrants; and in all the English colonies there are fair opportunities, though without any special demands, for artisans of every class.

We collate these details from the latest emigration circular by way of giving to those who are thinking of emigration an illustration of the correct and authoritative intelligence that is obtainable, without cost or trouble, almost at their very doors. The colonial governments of certain districts offer passages at reduced rates to agricultural laborers and female servants. To the latter, and to mechanics under contract with employers, Cape Colony supplies free and assisted passages. Domestic servants are in demand throughout the colonies, and farmers with capital and common sense need have no fear for their future if well advised as to the particular line

of country upon which they should settle. Fortunately at the moment, English trade is looking up; but at any time the prizes to be won by industry and good conduct are more numerous and of greater value than they can possibly be in the overpopulated districts of industrial England.

WHERE BRITISH EMIGRANTS SHOULD NOT GO.

[From the Pall Mall Gazette.]

British emigrants should avoid Chili. Those who have gone there have bought their experience dearly and wish themselves well out of the country. The Chilian Government are very anxious to introduce European labor, and made a contract in April last with the firm of L. de Llanos, Keates & Co., of Brussels, by which the latter undertook to recruit and forward to Chili 25,000 emigrants before the close of the year. Those sent out were largely from Spain, but England was also made a recruiting ground, and the first batch of British emigrants, who arrived at Santiago in November, were not long in discovering their mistake. They complained to Consul Kennedy of the incorrect representations made to them by certain subagents in England, and the misleading information contained in a pamphlet supplied to intending emigrants by the firm of Llanos and Keats. This is specially noticeable in the tables of Chilian money and salaries and wages set out in the pamphlet. There are dollars and dollars, and, as it happens, the Chilian paper dollar—gold and silver coins being practically unknown—is worth not 4*s.*, but about 2*s.* It has never been higher than 29*d.*, and has been as low as 21*d.* Owing to the depreciation and fluctuation in the value of the paper dollar, and to the high rate of import duties, more articles of ordinary use, such as clothing, and furniture, can be bought for a shilling in England than for a dollar in Chili. The wages appear large, calculated on the basis of 4*s.* to the dollar, but that requires to be halved in order to get at the real value, and even then the figures are too high. Farm laborers, instead of earning £7 to £10 per month, are paid about 1*s.* to 1*s.* 6*d.* per day, and are lodged in mud cabins thatched with bulrushes, and receive beans, bread, and water for daily food.

"Good agricultural laborers," Mr. Kennedy says, "from England or Scotland, or men acquainted with dairy work and cattle-farming, who are willing on first arrival to submit to the discomforts of bad food and lodging and small wages, may hope, within two years, or even sooner, to rise to a position of comparative ease; but, as a general rule, I would not encourage British subjects to try emigration to Chili; they are at a great disadvantage at first, as compared with Italians or Spaniards, or even Frenchmen, who pick up the language quickly, and accommodate themselves more easily to the customs and system of life of the natives."

Mr. Thomas, the vice-consul, takes the same view. "The English emigrant," he says, "is at the same time the best and worst of any which could be imported to this country. He is the most civilized of them, and consequently he brings with him a fund of physical and moral strength which would do immense good to the country in the long run if they could find room for him, and treat him as he deserves and is accustomed to be treated. But for those same reasons he is the most expensive, the most difficult to provide for during the first period of his life here, and because he is a good workman, who occupies all his time in gaining a livelihood for himself and family, if he has one, which is generally the case, he has neither time nor disposition for learning the language, which is of all his greatest difficulty."

COLONIZATION.

[Arnold White in London Echo.]

The successful settlement of willing workers on strange soil will never be accomplished until the difficulties at both ends of the line are so great as to demand the highest qualities of organization, foresight, and resolve. The history of the efforts at colonization during the present century is the history of failure—at all events, to the schemes as they were framed by the philanthropic inventors. The convict colonies of Australia, begun in spite of all reason, and pursued in defiance of all experience, were said at the time to be the beginnings of an "imprudent nation." But the sequel to these measures for peopling the vacant spaces of the earth all point to one conclusion. It is this—no matter how unpractical, how inadequate are the schemes adopted; no matter what pain is caused to the settlers forming part of the experiment, the benefit to the children of the first settlers, and to the mother country by the creation of fresh trade is so great as to be almost incredible. The Canterbury settlement in New Zealand was by no means a success in its original form; but the final issue of the scheme begun by Lord Lyttelton and Mr. Godley was supremely sucessful. The efforts of Lord Liverpool, in 1820, to relieve distress in England, and to people the eastern province of the Cape Colony, resulted in untold misery to the first settlers. But the property of the descendants of those settlers amounts at the present time to over £20,000,000.

Where the war-shout of Kaffirs once rang through the air, the morning hymn of blue-eyed English children now floats across the *veldt*. Where the settlers and their families were done to death, and their property burned and wasted, life and property is now as safe as in Sussex.

In 1857 Sir George Grey repeated Lord Liverpool's experiment, and settled in Kaffirland a legion of soldiers who had fought for us in the Crimea. The sufferings of 1820 were repeated. But thirty years afterwards the children of those German soldiers had reaped in peace and fortune the fruits their fathers had won for them by patience, by courage, and by industry. The lessons from these facts, and many more of similar teaching, are that we have still to learn how to organize success for the pioneers; how to insure a moderate proportion of fortune, health, and education for industrious men, women, and children, who are denied a livelihood in their own country; and how to arrange the outlay of capital so as to avoid pauperization on the one hand, and on the other the dishonest evasion of payment by the settlers.

As was stated in the preceding article on social questions, it is necessary, in the first place, to arrest the influx of pauper foreigners. It is idle to expect that the bone and sinew of England will expatriate themselves until the rubbish of other lands ceases to pour into our crowded labor market. The next point is to obtain suitable land in a suitable climate, with access to markets. It is hopeless to look to colonial governments to provide land. The estate they administer is held in trust for the colonial public, not for the mother country who obtained it by her blood and treasure. It is a waste of pen and ink for Lord Knutsford to ask the colonial governments to help us. We must help ourselves, and where sentiment, gratitude, and loyalty are powerless to obtain the land we want, self-interest will prove the magic lamp that opens any door. While the colonies will laugh at us if we ask their help for the love of the Queen, for affection to the old country, for gratitude towards those who have allowed them to occupy the lands in which they live, they will listen to us if we can show that there are dollars in our scheme.

My plan for obtaining land is this. It has been tried. It is succeeding at the Tennyson Settlement in South Africa. The unearned increment of value on land, arising from the residence of human beings in the neighborhood, operates as swiftly and as truly in Australia, in South Africa, or in Canada, as on Lord Cadogan's or on the Duke of Bedford's London properties. In the colonies land is held in vast tracts. If a Cape Dutchman sees another man's smoke in the far horizon he thinks himself

crowded, and contemplates migration to a less populous place. Little or nothing is done to some of these vast estates, and their value is potential rather than existent. Enlightened people are to be found in the colonies quite as readily as in England. On pointing out to these lords of the soil that the value of the whole would be increased by placing an industrious population on a portion of the estate, it will be possible to obtain the cession in perpetuity of land for settlement for the consideration of locating an industrious population, equipped with the raw material of success, on the land ceded, the population thus placed to pay the original owners a moderate rate of quit-rent, on the same plan as that adopted for Government or Crown lands. Often it happens that the part is greater than the whole. The size of the cake is immaterial if your portion of it is satisfactory to you. But to carry out this plan honest men are needed. Too many rogues have made of emigration a happy hunting ground.

WAGES IN EUROPE AND IN THE UNITED STATES.

[Note by the Department of State.]

Throughout the foregoing work repeated references are made to the rates of wages in Europe and the United States. As such references are not based on exact official data, the following tables from "Labor in Europe," as published by the Department of State, are given.

These tables cover the year 1884, but the relative conditions in Europe and in the United States have not materially altered since then, so that the rates are, generally, as applicable to the year 1890 as they were to 1884.

I.—GENERAL TRADES.

Comparison of the average weekly wages paid in the general trades in Europe with those paid in similar trades in New York and Chicago.

Occupations.	England and Wales.	Germany.	France.	Belgium.	Austria.	Holland.	Switzerland.	Russia.	Chicago.	New York.
BUILDING TRADES.										
Bricklayers	$7.56	$4.21	$5.74	$4.56	$3.55	$4.80	$5.21	$4.32	$24.00	$20.00
Hod carriers	4.94	2.92	3.13	3.22	2.08	3.60	2.99	2.45	10.50	11.00
Masons	7.68	4.07	5.33	5.22	3.73	4.80	5.27	6.72	24.00	18.00
Tenders	5.07	3.15	3.23	3.09	1.92	4.00	3.50	2.88	10.50	10.00
Plasterers	7.80	4.43	6.34	4.66	4.01	4.00	5.03	4.61	27.00	18.00
Tenders	5.27	2.91	3.23	3.02	1.82	4.00	3.40	2.55	15.00	10.00
Slaters	7.10	4.20	5.65	4.98	4.00	4.00	4.35	4.20	21.00	14.00
Roofers	7.35	4.28	5.65	4.97	4.20	.....	2.99	3.75	16.50	12.00
Tenders	4.24	2.81	3.64	3.28	2.80	.....	3.18	2.60	10.50	9.00
Plumbers	7.90	4.26	6.10	5.46	4.11	4.80	5.18	4.32	22.50	16.00
Assistants	4.69	2.72	3.61	2.93	2.41	2.80	3.36	2.30	5.70	10.00
Carpenters	7.66	4.11	6.20	4.07	5.10	4.80	4.74	3.30	16.50	14.00
Gas fitters	7.66	4.08	6.07	5.00	6.09	5.60	5.04	3.76	18.00	12.00
OTHER TRADES.										
Bakers	6.17	.....	.....	4.28	4.55 / 4.72	4.80	3.88	2.92	12.00	7.00
Blacksmiths	7.37	4.00	5.81	5.38	3.18	4.80	5.20	3.72	15.00	13.00
Strikers	5.30	2.94	4.72	3.29	3.15	3.60	4.43	2.72	10.50	9.00
Bookbinders	6.77	4.20	5.17	5.35	4.10	4.00	4.68	3.42	16.50	14.00
Brickmakers	*7.00	3.98	5.32	4.25	6.20	3.20	4.43	2.80	17.40	10.00
Brewers	6.85	.....	4.43	4 46	5.87	6.00	3.78	4.06	.....	5.00
Butchers	5.50	3.32	.....	4.31	3.50	3.60	4.66	2.91	16.50	8.00
Brass founders	7.47	4.38	6.54	6.02	3.60	4.00	4.92	4.20	15.00	10.00
Cabinetmakers	7.68	4.25	6.14	5.66	4.40	4.80	5.59	5.76	15.00	12.00
Confectioners	6.84	3.43	4.85	5.03	.....	4.40	5.84	3.36	12.00	.....
Cigar makers	6.07	3.63	4.69	6.28	3.00	4.00	3.30	3.80	18.00	11-15

*About.

Comparison of the average weekly wages paid in the general trades in Europe with those paid in similar trades in New York and Chicago—Continued.

Occupations.	England and Wales.	Germany.	France.	Belgium.	Austria.	Holland.	Switzerland.	Russia.	Chicago.	New York.
OTHER TRADES—continued.										
Coopers	$7.50	$3.97	$5.58	$5.17	$3.64	$4.80	$4.78	$3.66	$12.00	$12.00
Cutlers	7.00	3.90	5.16	5.28	3.00	.....	4.93	3.91	.....	10.00
Distillers	.....	3.56	7.06	5.00	3.00	6.00	4.02	4.00	.....	9.00
Drivers	.....	.....	4.80	3.95	.....	5.00	.....	3.50	.....	.....
Draymen and teamsters	5.37	2.96	5.57	3.77	2,20	4.40	.....	3.60	12.00	10.00
Cab and carriage	5.15	3.21	4.82	3.92	4.00	2.50	.....	3.60	.....	9.00
Street railways	6.09	3.44	4.47	4.09	3.68	4.40	3.84	2.95	13.50	11.00
Dyers	6.18	3.45	4.83	6.15	3.80	3.60	4.91	3.16	16.50	13.00
Engravers	8.38	5.12	7.35	6.42	4.77	8.00	6.35	4.66	24.00	16.00
Furriers	*8.52	4.20	7.00	6.35	3.67	4.00	4.63	3.66	15.00	13.00
Gardeners	5.80	3.78	5.11	3.91	.....	3.60	3.83	3.90	12.50	9.00
Hatters	6.10	4.36	5.50	4.60	3.85	4.00	3.84	5.10	.....	13.00
Horseshoers	6.32	3.61	5.89	5.62	1.20 / 3.48	4.40	4.65	3.75	18.00	13.00
Jewelers	8.76	5.21	6.24	6.84	3.80	.....	6.35	4.15	13.50	11.00
Laborers, porters, etc	4.70	3.11	3.93	3.77	3.00	3.20	3.61	2.88	10.50	9.00
Lithographers	7.07	5.59	7.07	5.86	5.93	4.80	5.51	4.88	.....	12.00
Millwrights	6.97	4.18	6.74	5.00	3.10	4.80	6.30	3.30	.....	14.00
Nailmakers (hand)	5.90	3.12	4.84	.....	.....	.....	2.64	3.65	.....	.....
Potters	5.20	3.60	4.78	4.86	3.17	.....	4.17	5.76	.....	10.00
Printers	7.17	.....	6.64	5.94	4.85	6.00	5.93	5.76	18.00	13.00
Teachers public schools	†12.00 / ‡7.70	.....	7.00	7.74	8.47	6.40	.....	9.60	.....	13.00
Saddle and harness makers	6.63	3.69	5.70	5.51	3.80	.....	5.20	5.10	12.00	11.00
Sailmakers	7.02	2.85	6.04	4.56	3.80	4.80	.....	2.59	15.00	12.00
Shoemakers	.....	2.95	2.90	.....	.....	4.00	.....	.....	.....	11.00
Stevedores	8.44	5.70	6.72	4.36	7.40	.....	.....	2.88	18.00	12.00
Tanners	6.38	4.85 / 3.80	5.18	5.81	4.15	4.00	4.92	4.90	.....	.....
Tailors	7.40	3.41	5.02	5.58	4.03	5.00	6.36	3.42	.....	7.12
Telegraph operators	7.65	5.11	6.92	6.35	6.75	5.60	.....	6.55	.....	12.00
Tinsmiths	6.56	3.55	5.46	4.40	3.70	4.00	4.40	2.96	12.72	11.00
Weavers (outside of mills)	6.31	2.79	3.23	3.95	3.15	3.60	3.05	2.96	.....	10.00
Machinists	.....	4.60	.....	.....	.....	.....	.....	.....	18.00	.....
Painters	.....	4.82	.....	.....	.....	.....	.....	.....	12.00	.....
Upholsterers	.....	4.52	.....	.....	.....	.....	.....	.....	18.00	.....

* With board. † Men. ‡ Women.

To reduce the foregoing statements to an equitable level of comparison, the following tabulation is given, showing the rates of wages in the principal cities of Europe as compared with those in the United States:

I.—GENERAL TRADES.

Occupations.	London.	Antwerp.	Bremen.	Berne.	Vienna.	Amsterdam.	Rouen and Marseilles.	Copenhagen.	Turin.	Riga.	Chicago.
BUILDING TRADES.											
Bricklayers	$8.40	$4.40	$4.50	$7.50	$4.50	$4.80	$6.95	$7.00	$4.20	$4.32	$24.00
Hod carriers	4.60	3.12	3.50	2.22	2.60	3.60	3.47	4.30	1.70	2.45	10.50
Masons	8.40	6.00	5.00	6.06	3.40	4.80	5.79	5.36	3.60	6.72	24.00
Tenders	4.60	3.12	3.65	3.90	2.60	4.00	3.47	4.29	1.70	2.88	10.50
Plasterers	7.50	4.40	4.50	6.36	3.65	4.00	6.95	6.97	5.04	6.72	27.00
Tenders	4.60	3.12	3.61	3.90	1,72	4.00	3.47	3.86	1.70	2.60	15.00
Slaters	7.50	5.00	4.35	3.78	4.00	4.00	6.94	.....	4.20	4.80	21.00
Roofers	7.50	.....	4.35	3.78	4.20	.....	6.94	8.00	4.20	3.75	16.50
Tenders	4.60	.....	3.39	3.08	2.80	.....	4.34	4.50	1.70	2.60	10.50
Plumbers	8.10	4.40	4.57	4.94	4.50	4.80	6.95	6.90	3.60	4.32	22.50
Assistants	4.87	3.05	3.20	3.36	2.50	2.80	3.47	4.29	1 70	2.30	5.70
Carpenters	8.00	4.82	5.00	5.20	5.50	4.80	7.50	7.00	4.00	4.80	16.50
Gas fitters	8.00	5.79	4.11	3.78	5.18	5.60	7.50	5.90	3.40	5.28	18.00

I.—GENERAL TRADES—Continued.

Occupations.	London.	Antwerp.	Bremen.	Berne.	Vienna.	Amsterdam.	Rouen and Marseilles.	Copenhagen.	Turin.	Riga.	Chicago.
OTHER TRADES.											
Bakers	$6.50	$2.70	$3.55	$4.32	$4.75	$4.80	$4.84	$4.25	$4.00	$3.84	$12.00
Blacksmiths	7.80	5.50	4.28	5.40	3.50	4.80	6.00	4.82	3.60	3.84	15.00
Strikers	6.00	2.45	3.57	4.62	3.35	3.60	5.00	4.82	3.40	2.75	10.50
Bookbinders	7.00	4.63	5.15	4.80	4.20	4.00	6.18	4.82	3.80	3.84	16.50
Brickmakers	6 00	3.20	4.75	4.92	3.40	3.20	6.00	5.90	5.00	3.36	17.40
Brewers	7.00	3.20	4.61	3.78	4.20	6.00	6.00	3.75	8.00	5.76	15.00
Butchers*	4.38	2.90	3.60	4.32	4.50	3.60	5.00	4.37	.....	4.32	16.50
Brass founders	8.10	6.95	4.28	4.92	4.00	4.00	7.50	4.82	4.60	4.80	15.00
Cabinetmakers	8.80	6.00	3.33	4.62	4.00	4.80	7.90	4.58	3.40	5.76	15.00
Confectioners	6.00	4.65	3.43	6.36	.....	4.40	4.85	4.25	3.75	3.60	12.00
Cigar makers	6.80	6.50	4.19	3.30	3.00	4.00	6.00	5.09	3.00	6.00	18.00
Coopers	8.00	3.47	4.28	3.78	4.20	4.80	6.95	4.82	2.60	4.32	12.00
Cutlers	8.00	4.65	3.91	4.32	3.00	.....	5.79	6.10	3.80	4.32	.....
Distillers	.....	5.21	2.86	4.02	4.00	6.00	5.79	4.50	4.20	5.76	50.00
Drivers:											
Draymen and teamsters.	6.50	2.95	3.17	3.06	2.40	4.40	7.53	3.22	1.50	3.60	12.00
Cab and carriage	5.00	3.00	2.46	3.06	4.60	2.50	5.40	4.80	2.50	3.60	.....
Street railways	7.50	4.63	3.10	3.06	4.05	4.40	4.82	4.29	3.60	2.40	13.50
Dyers	7.50	6.00	3.53	4.62	4.00	3.60	6.00	4.29	3.20	4.32	16.50
Engravers	8.50	6.00	4.92	5.76	4.60	8 00	8.75	8.00	6.60	4.32	24.00
Furriers	8.50	7.53	3.15	5.22	4.60	4.00	8.50	5.36	4.60	4.32	15.00
Gardeners†	5.20	4.40	3.10	3.66	.....	3.60	5.79	4.00	4.00	4.80	12.50
Hatters	5.40	4.75	4.35	4.62	4.00	4.00	5.21	5.00	5.20	7.20	.....
Horseshoers	7.10	4.05	3.00	3.61	3.48	4.40	5.79	4.82	5.20	4.80	18.00
Jewelers	8.00	6,50	5.67	5.76	5.20	.....	8.80	5.36	3.80	4.80	13.50
Laborers, porters, etc	4.87	3.47	3.63	3.78	3.20	3.20	5.00	4.29	3.60	2.83	10.50
Lithographers	8.50	5.80	3.90	3.78	5.60	4.80	9.00	5.50	.....	5.76	24.00
Millwrights	8.70	3.00	3.57	6.60	3.10	4.80	9.80	5.87	.....	4.80	.....
Nailmakers (hand)	.....	.....	3.57	2.64	.....	.....	4.84	4.82	3.20	4.80	.....
Potters	4.40	4.25	4.28	3.78	3.20	.....	6.10 / 11.58	4.22	5.20	5.76	.....
Printers	7.30	5.80	.....	6.06	5.80	6.00	11.00	5.36	4.60	5.76	18.00
Teachers:											
Males	15.00	7.45	.....	.....	.....	.....	.....	.....	.....	.....	.....
Females	7.60	.....	.....	.....	6.00	6.40	10.00	10.00	5.00	9.60	.....
Saddle and harness makers	7.80	5.00	3.75	4.32	4.50	.....	7.25	4.82	.....	4.50	12 00
Sailmakers	7.30	5.80	2.85	.....	3.80	4.80	6.95	4.82	2.80	2.59	15.00
Stevedores	8.00	5.00	5.70	.....	7.40	.....	5.79	5.00	2.00	2.88	18.00
Tanners	7.00	5.50	3.57	4.92	4.50	4.00	6.94	5.09	2.20	4.80	16.00
Tailors	7.50	4.50	3 95	6.36	4.40	5.00	6.00	5.50	4.00	3.84	15.00
Telegraph operators	8.00	6.50	5.75	.....	7.50	5.60	8.60	6.50	5.20	5.25	20.00
Tinsmiths	7.00	3.47	4.25	3.66	4.20	4.00	6.90	6.70	6.60	4.32	12.72
Weavers (outside of mills)	.....	.....	2.50	2.64	3.30	3.00	3.50	3.00	5.20	4.00	.....

* With board. † With house.

From the foregoing statement it appears that bricklayers and masons in Chicago are paid very nearly three times the wages; plasterers, nearly four times; slaters, three times; plumbers, nearly three times; carpenters, twice; blacksmiths, twice; bookbinders more than twice; brickmakers, nearly three times; brass founders and cabinetmakers, nearly twice; confectioners, twice; cigar makers, nearly three times; coopers, once and a half as much; draymen, teamsters, and street railway drivers, nearly twice; dyers, more than twice; engravers, nearly three times; furriers, twice; horseshoers, three and one-half times; jewelers, more than one and one-half times; laborers, porters, etc., more than twice; lithographers, three times; telegraph operators, twice and one-half; sailmakers, more than twice; printers, twice and one-half times; saddlers and harness makers, more than one and one-half times; stevedores, more than twice and one-fourth times; tailors, twice; and tin-smiths, once and three-fourths the wages paid to similar trades and callings in London.

PRICES OF THE NECESSARIES OF LIFE.

[From Labor in Europe.]

The next obvious basis for a comparison is the purchasing power of the wages earned in the several countries.

It is frequently asserted that the cheapness of living in Europe more than equalizes the lower wages there paid.

In the volume on labor in Europe, published by this Department in 1878, it was shown that the prices of food in the United States were actually lower than in Europe, and that the working classes in the United States could purchase more and better aliment, dollar for dollar, than the working classes of any country in Europe. The contrary impression is probably due to the fact that the working people of Europe live more cheaply than the working people of the United States, from which it is inferred that the purchasing power of their wages is greater than the purchasing power of similar wages here. It appears from the reports hereto annexed that the American workingman consumes more and better food than the mechanic or laborer abroad, and that the cost of this food is as small in the United States as in Europe.

The following statement gives the retail prices of the principal articles of food consumed by the laboring classes in seven European countries, and of the same articles in New York, Chester, Pa., Newark, N. J., and Chicago. The European statistics are compiled from the consular reports, and those for the United States have been kindly supplied by the same person who furnished the rates of wages in the cities named:

Retail prices of the necessaries of life in Europe and the United States.

Articles.	England (Liverpool).	Germany (Berlin).	Switzerland (Berne).	France (Marseilles and Rheims).	Austria (Vienna and Prague.)
Meats:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Bacon ..... per pound..	12 to 20	.....	.....	15 to 20	15 to 18
Ham ..... do....	24	25 to 30	— to 30	40 60	30 38
Beef ..... do....	14 20	17 20	15 18	14 30	10 10
Mutton ..... do....	16 20	17 20	14	14 25	9 16
Veal ..... do....	16 20	22 25	16 18	25 35	9 18
Pork ..... do....	16 20	16 20	18 20	15 20	.....
Sausage ..... do....	16 20	.....	.....	.....	.....
Horse and donkey flesh ..... do....	.....	.....	.....	5 13	.....
Groceries:					
Sugar ..... per pound..	4 7	8 13	8	6½ 12	7 8
Tea ..... do....	32 89	70 $2.00	$1.00 $1.50	$1.00 $1.40	.....
Coffee ..... do....	24 40	20 40	18 32	35 60	.....
Butterine ..... do....	12 24	.....	.....	.....	.....
Butter ..... do....	24 32	20 38	30	32 60	25 27 16 28
Dripping ..... do....	12 16	.....	.....	.....	.....
Lard ..... do....	12 16	18	20	12 16	12 16
Cheese ..... do....	12 22	20	.....	14 24	.....
Rice ..... do....	4 8	5 10	6	5 10	6
Flour ..... do....	3⅓ 4	4½ 5½	4 6	5 10	3 5
Corn meal ..... do....	.....	5½ 6	.....	3 5	.....
Bread ..... do....	2½ 4	5 9	4 5	.....	3
Oatmeal ..... do....	4 9	5½ 6	.....	.....	.....
Potatoes ..... do....	⅛ 1	1	8	1 2	1 2
Cabbages ..... each..	2 5	.....	.....	4 12	.....
Codfish ..... per pound..	8 12	9	.....	.....	.....

Retail prices of the necessaries of life in Europe and the United States—Continued.

Articles.	Belgium (Brussels).	Holland (Amsterdam).	New York.	Chicago.	Chester, Pa.	Newark, N. J.
Meats:	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Bacon..... per pound..	16 to 20	16 to 18	16 to —	14 to 20	— to 12	— to 18
Ham.....do....	30	16 26	16	14 18	11 16	12 18
Beef.....do....	15 17	15 29	10 25	6 15	8 56	16 22
Mutton.....do....	18	16 24	11 15	9 12	9 18	14 16
Veal.....do....	18	14 22	17 25	10 18	10 20	8 20
Pork .....do....	16	.....	8 13	12½	10 15	12 18
Sausage .....do....	.....	.....	16	10	12	15 18
Horse and donkey flesh.do....	.....	9 13	.....	.....	.....	.....
Groceries:						
Sugar.....per pound..	12	9 15	8	7 8½	6½ 8	8
Tea.....do....	.....	17 54	25 70	25 1.60	30 80	40 60
Coffee .....do....	16	13 25	20 32	20 35	20 25	30
Butterine..... ....do....	.....	16 22	.....	.....	.....	.....
Butter.....do. ..	20	22 33	30	20 28	25 32	25 35
Lard.....do....	.....	16 22	15 16	12½	12	14 16
Cheese.....do....	.....	13 23	20	12½ 14	12 16	16 18
Rice .....do....	4 5	3½ 6	10	5 9	8 10	10
Flour.....do....	.....	4 6	5	3 5	3 4	3 4
Bread.....do....	3 5	2½ 5½	.....	5 7	5	.....
Oatmeal .....do....	.....	.....	.....	4	5	6
Potatoes.....do....	1	1	.....	1½	1½	2½
Cabbages..... each..	2	.....	.....	.....	.....	.....
Codfish ..... per pound..	.....	.....	.....	8 12½	5 8	12

It should be borne in mind, in making a comparison, that the better classes of food, the beef, mutton, veal, butter, and rice, are not only for the most part cheaper in the great cities of the United States than in Europe, but they are here daily necessaries for the table of the better grade of skilled workmen, rarely absent from some one meal of the day, and often present at the morning and evening meal; while the concurrent testimony is that, even to the best-paid working classes of Europe they are, in the main, luxuries which are seldom enjoyed; so that, as far as meats of all kinds are concerned, especially fresh meats and ham, they can be passed over as of little comparative value. The lower classes of Europe usually eat dark or black bread, so that even wheat flour and wheat bread may be set aside with the meats as furnishing no sufficient basis for comparison.

Besides this, several articles which are staples of food in Continental Europe, the *garbanzos* or chick-peas of Spain, the *poleata*, or coarse corn meal with bran, of Italy, the blood puddings of Germany, and the like, are not found in the markets of the United States; so that, outside of England, where the food supplies approximate in kind and degree to those of this country, there is but little left in common whereby to make comparisons between the food-purchasing power of wages in Europe and the United States.

The working classes of Europe live mainly on black or rye bread, potatoes, cheap coffee and tea, vegetable soups, and lard and olive-oil of a low grade take the place of butter.

As to quality, the contrast which has been mentioned in the case of bread and breadstuffs extends to many other items of the list. The coffee of the poorer classes, for instance, is not only of a lower class, but is largely adulterated with chicory and fortified by a so-called "coffee essence." Consul Smith of Mayence reports an instance of a laborer at Mayence earning 50 cents a day on which to maintain himself, a wife and five children, who buys among other things "a package of 'surrogate coffee,' which lasts about two weeks," and which costs 2½ cents.

The standard noonday meal of the working men of Mayence is thus given by Consul Smith: Potatoes and a little meat with peas or beans cooked together in the form of a thick soup, to which a little green cabbage or lettuce is sometimes added. This dish they eat day after day with very little change in the character of its contents or in the manner of its preparation. This is the dinner eaten at his work; the food of the wives and children at home is said to be cheaper and less nutritious.

SPECIAL CONSULAR REPORTS.

OLIVE CULTURE

IN THE

ALPES MARITIMES.

REPORT FROM CONSUL BRADLEY, OF NICE, IN ANSWER TO A CIRCULAR FROM THE DEPARTMENT OF STATE.

ISSUED FROM THE BUREAU OF STATISTICS, DEPARTMENT OF STATE.

ALL REQUESTS FOR THESE REPORTS SHOULD BE ADDRESSED TO THE SECRETARY OF STATE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1891.

OLIVE CULTURE IN THE ALPES MARITIMES.

REPORT BY CONSUL BRADLEY, OF NICE.

INTRODUCTORY REMARKS.*

I have the honor to send herewith my report on olives. The Alpes Maritimes produces more of them than any department of France with one exception, and probably now gives more scientific attention to their culture than any. It is decidedly the most important agricultural industry of my district. Since receiving the questions from the Department of State I have received letters from California, Texas, and Florida in regard to them.

For these reasons, and as I am somewhat familiar with the language, I felt it necessary to look into the subject with some care personally, and give something of the researches made by scientists of late years, particularly of M. Peragallo on the insects more or less harmful to the tree and fruit; of M. Gos on manures and pruning; and Mr. Brullé on adulteration. There is a great deal of adulteration of the olive oil, and Mr. Brullé finds it hard to gain recognition for his discoveries.

*This valuable report was received too late for insertion in "Fruit Culture in Foreign Countries."

IMPORTANCE OF THE OLIVE TREE.

Importance of the tree.—Mr. Gos, in his interesting little brochure on the regeneration of olive culture, says regarding the importance of the tree to the agricultural community:

It is possible in this mild climate and near the sea to obtain in good soil from other plants that can be raised to perfection net products worth more than can be realized from the same extent of land planted in olives; but given identical conditions of soil nothing gives equal results. The soil it occupies would be without the olive left barren. It encroaches upon the territory of no other plant, and to dig it up is generally a bad speculation. The olive prospers and yields its oil, so highly esteemed, in calcareous, gravelly, dry, or arid soils in the narrow valleys of the "Alpes Maritimes," on slopes precipitous and water washed, which could not be used for the culture of annuals. It is, besides, a forest tree of the highest order, and its disappearance from our region would be a veritable calamity.

The olive covers about 70,000 acres in the department of "Alpes Maritimes," it yields a revenue of $2,000,000, and is the only income of many families.

VARIETIES.

There seems to be but two species of olive trees in the south of France: First. The Oleaster (wild olive), having a kind of thorn, very short leaves, and producing only a few small berries, which neither the Dacus nor the boring caterpillar will attack.

Second. The Sativa (cultivated olive), leaves lanceolate, fruit large, often attacked by the dacus. Seedlings of the sativa sometimes deteriorate so as not to be distinguished from the oleaster.

Varieties are as numerous as those of peaches or other fruits in the United States. From fifty to a hundred have been described and named in much the same arbitrary manner, with this perplexing difference, that the names are given in five or six different languages or dialects.

Mr. Barbe, sr., in his "Etudes sur les Oliviers," describes four varieties, as follows: The Blanquetier, which grows large, branchy, with light green foliage; the fruit is small, the pulp has at first a bitter taste, then a mellow after taste; the oil is abundant; it blossoms freely, but too often disappoints the hopes of the farmer for fruit.

The Blavier, which has a very rustic appearance, is very hardy; its fruit is oblong and comparatively large; the pulp is coarse, the oil deeply colored; the fruit is sensitive to cold.

The Arabanier or Araban is less rustic and less lofty than the last; its foliage is poor, the fruit round; the oil is of ordinary quality, better when made from fruit not quite ripe. This tree is hardier than either the Blavier or the Blanquetier, and resists better the effects of wind and frost.

The Cailletier, well known and popular for years past, grows tall; its branches hang low, the leaves are glossy dark green on the upper surface, nearly white underneath; the bark is rough and of a gray hue; the tree appears less green than the other varieties because of the disposition of the branches; the fruit, in clusters at the ends of the branches, is of good size, convex on one side, concave on the other; yields oil which is of superior quality in all points. This tree, also known by the characteristic name of Pendoline, thrives best in dry lands; at its best, its fruit sells for a third more than others for mixing with poorer qualities. It is a robust tree and can be severely pruned. Its greatest enemy is the Dacus oleæ or Keïron. Cattle, too, if pastured in the grove, must be kept from its low-hanging branches. Other good varieties for oil are the Nirvana, also called Noustrales and Brocienne; the Auriola, also called Pignola; the Nicoise, the Blanche, the Roberon, the Negrette, the Sager, the caillan, etc.

For preserving the Verdale, a large oval fruit, the Amenlean, the Lucques, a small variety with sharp pointed stone. The Poncinere, grown everywhere in the "Alpes Maritimes," the Calliache, too, and the Picholine are well liked.

WORKING AN OLIVE ORCHARD.

With the olive, however, as with our fruit trees, the best named do little if left to themselves; care and cultivation seem of even more importance than the name of the variety, although it is certainly advantageous to get young trees from groves which have made some varieties celebrated.

I would suggest for the commencement of a grove the Cailletier and Nirvana, or Noustrales for oil, and the Verdale and Lucques for preserving.

Propagation.—The olive is propagated readily by any of the methods in use among our fruit orchards. A Nicois farmer who wishes a new grove generally transplants wild young trees, planted by the birds in the woods, and when they are well started grafts upon them the desired variety. The wild stocks give hardier trees. For a long time it was thought almost impossible to cause an olive stone to sprout; but the fact that seeds, having passed the digestive organs of birds, sprouted readily enough, taught that only a thorough washing, to remove the oily substance which protects the stone from moisture, was necessary to produce the desired result; some, however, plant only the kernel. Cuttings from root or branch, well soaked for a day be-

fore being planted at a depth of 5 or 6 inches and afterwards watered, do well.

Planting.—Trees in an orchard should be at least 45 or 50 feet apart.

Cultivation.—It pays to work the ground lightly around the olive trees several times a year, not deep enough to break the rootlets, which are wide-spreading, but enough to let the moisture penetrate readily and destroy the weeds.

Manuring.—The question of manure is one of utmost importance, and for the double reason that elements taken from the soil by successive crops must be restored to prevent utter exhaustion of the soil and consequent deterioration of the crop and fruit, and that we may give strong appropriate food to the tree to increase the amount and value of the fruit. To accomplish all these ends analyses of soil, wood of the tree, leaves, and fruit at different seasons of the year must be made to find out what elements are needed. Here the authorities only differ as to amounts and frequency of application, some trying to produce a crop every year, others a crop every 2 or 3 years. Mr. Peragallo says, every 2 years in winter, before the rains, give each tree either 450 pounds of barnyard manure or 6½ pounds of guano; in odd years give them either fresh earth, soot, or plaster taken from old buildings.

Mr. Barbe says: Nothing comes amiss, from weeds, plowed under, to woolen rags, the latter preferred to almost anything, sometimes mixed with horn and old leather; this only needs renewing once in 6 years. To avoid generation of too great heat the rags, horn, or leather should not be buried deep nor close to the tree trunk.

Mr. Brullé, of the Nice Agronomic Station, has carried out a very complete series of experiments which space forbids translating in full. He says:

> Our final decision was that sulphate of ammonia and woolen rags were the best manures. The first increased the crop and fruit, the second produced a strong, healthy growth of wood and leaves necessary to the welfare of the trees. Forcing young trees with sulphate of ammonia must be done with care, for they can not produce wood enough to keep up the proper balance between the crop and growth of the tree.

He gives, finally, as a formula for young trees:

	Kilos.
Woolen rags	4
Chlorate of potash	0.350
Sulphate of iron	0.350

This amount to each tree.

For older trees in full bearing, the quantity for each tree as follows:

	Kilos.
Woolen rags	3
Sulphate of ammonia	0.500
Chlorate of potash	0.350
Sulphate of iron	0.350

In the two formulæ the sulphate of iron and ammonia should be put on in the spring, the rest in autumn.

The lectures that Mr. Gos, professor of agriculture at Nice, delivers to the farmers throughout this department on this subject are so full of interest that I give large extracts as follows:

"Hardy as it is, the olive tree is not an exception in the vegetable kingdom. It demands for the best results an abundant and appropriate nourishment, and its harvest is given in proportion to the amount of manure used; if the soil, as is often the case, is not provided with the elements which are indispensable to its welfare, the olive tree decays and its fruitfulness is checked. It is not to be denied that many groves live on exhausted lands, and it is often the case of those which formerly produced largely. Nothing is more logical and natural; it is not possible to obtain crops from a soil for an indefinite length of time without ever restoring some of its elements taken each year with the crop. The farmer who does not give back these elements, or, in other words, does not manure, robs his land, the consequence being unproductiveness and a gradual reduction in quantity and quality of the crop.

However, restitution to be equitable can not be left to chance. There are sundry kinds of manures, and the nature and quality of elements taken from the soil by an olive crop must be known. The chemical analysis without giving strictly accurate results affords useful indications. Mr. de Grasparin appears to be the first who was interested in this question, but his analyses are not complete. After him Mr. Audoynard, the erudite master of the agricultural school of Montpelier, published on the olive tree an excellent pamphlet giving very definite information as to the needs of the tree. He writes as follows:

"Plants, not excepting the olive tree, contain mineral principles which are found again more or less modified in their ashes after their combustion. The composition of these ashes does not show, it is true, the nature of the mineral compounds which are useful to the plant; but for some of them, such as potash and phosphoric acid, it can give useful indications. This induced me a few years ago to study the ashes of the wood, leaves, and fruit of the olive tree.

My analyses were directed at first to young stalks from 2 to 5 years old, with their leaves. They came from several varieties of olive trees in the environs of Nice. Collected in May, 1870, they were not burned to ashes until December. They had been left 7 months in my laboratory, the temperature of which varying from 15° to 25° and from 25° to 10° C., and had become very dry, the leaves breaking in the fingers. It is in that state that they were burned. The description of the results obtained is as follows:

Ashes of young stalks and leaves.

Varieties of olive trees.	Weight of the stalks.	Weight of the ashes.	Ashes per 100 of stalks.	Weight of the leaves.	Weight of the ashes.	Ashes per 100 of leaves.
Wild	217	6	2.70	58	4	6.89
Colomban (*a*)	135	4.4	3.26	114	5.2	4.56
Poncineri	91	2.5	2.74	81	4	4.94
Ordinary (*b*)	125	3.3	2.64	104	5	4.80
Sala	150	3.1	2	82	4.5	5.48
Total	718	19.3	.....	439	22.7	.....

	Ashes.
Average for 100 of stalks	3.66
Average for 100 of leaves	5.17

I afterwards analyzed the two varieties, *a* and *c*, and found the chemical substances as indicated in the following description:

Description.	Mineral substances found in 1 gramme of ashes of—			
	Stalks.		Leaves.	
	a	*b*	*a*	*b*
Carbonic acid (CO^2)	0.195	0.148	0.280	0.222
Phosphoric acid (PhO^5)	0.049	0.033	0.080	0.037
Potash (KO)	0.135	0.147	0.154	0.145
Lime (C_aO)	0.225	0.180	0.324	0.258

Those olive trees came from a calcareous soil and still their ashes do not show a large proportion of lime; the quantities of potash and phosphoric acid are below those generally found in the vine branches.

In taking the averages of the preceding numbers it is found that 100 parts of—

Dry stalks—
- Contain in phosphoric acid 0.10
- Contain in potash 0.35
- Contain in lime 0.50

Dry leaves—
- Contain in phosphoric acid 0.29
- Contain in potash 0.74
- Contain in lime 1.45

MINERAL COMPOSITION OF THE FRUIT OF THE OLIVE TREE.

It also seemed to me useful to find the principal mineral substances contained in the olive. I at first proceeded to the burning to ashes, which presents some difficulties. At the first exposure to fire the olives flame and are speedily covered with a white crust which stops the combustion; as this crust is soluble in water, a washing dissolves it. After two or three washings a perfect incineration is obtained, and this last product, with the residue of washing, composes the ashes. In following this method I got the following results for four samples of olives, three coming from a calcareous and one from a siliceous soil. I designate the

three first samples by the three letters, *a*, *b*, *c*, and the fourth one by *d*; the sample *c* came from wild olives.

The weight of the ashes of 1 kilogramme of olives is as follows: For *a* 20.77 grammes olives coming from Grasse; for *b*, 17.28 grammes olives coming from Biot; for *c*, 11.82 grammes olives coming from Biot; for *d*, 13.73 grammes olives coming from Biot.

I looked for the phosphoric acid, potash, lime, and magnesia contained in the ashes; the proportions found were:

Mineral substances contained in 1 gramme of olive ashes.

Description.	*a.*	*b.*	*c.*	*d.*
	Gramme.	*Gramme.*	*Gramme.*	*Gramme.*
Carbonic acid (CO^2)	0.140	0.158	0.100	0.128
Phosphoric acid (Ph. O^5)	0.072	0.064	.....	0.070
Potash (KO)	0.242	0.240	0.188	0.159
Lime (C_aO	Traces.	Traces.	Traces.	Traces.
Magnesia (m. G. o)	Very little.	Very little.	Very little.	0.004

There is then very little magnesia and lime; this, even for the olives grown in calcareous soil, appears to have stopped in the leaves, and not to have gone as far as the fruit. On the other hand, the olives coming from a calcarous soil contain more potash than those grown in siliceous soil; therefore it would be supposable that there is a kind of relation between the acids united to the lime in the leaves and the potash of the fruit; besides the potash appears to have a strong influence on the abundance and quality of the fruit.

I asked myself whether that potash belonged more to the stone than to the fruit. Thirty-seven olives (*a*) kept uninjured for 4 years gave 20 grammes of pulp and as much of stone; the pulp gave 0.596 gramme of ashes containing 0.185 gramme of potash, and the stones 0.482 gramme of ashes containing 0.138 gramme of potash.

The pulp thus contains a very large proportion of potash, and this fact appears to me to have a certain importance; in any case it is rather singular to find at the same time with an oily substance the alkali which apart could saponify it. If we take in 1 gramme of ashes an average of 0.070 gramme of phosphoric acid and 0.200 gramme of potash, we find that in 1 kilogramme of olives there is an average of 18 gramme-of ashes containing 1.3 grammes of phosphoric acid and 3.6 grammes of potash.

CONSUMPTION OF THE OLIVE TREE IN NITROGEN, PHOSPHORIC ACID, AND POTASH.

A hectare of sloping or rolling land may contain 200 middle-sized olive trees, but only 125 on level ground. To calculate the yield an average of 150 of good-sized growth may be taken. The hectare giving on an average per year, 4,500 liters of olives, an olive tree will give 30. It is on an olive tree of this annual produce that we are going to estab-

lish our calculations. The weight of a liter of olives being 600 grammes the above olive tree produces 18 kilogrammes of olives.

Mr. de Gasparin admits that an olive tree loses yearly in leaves half the weight of the crop, say 9 kilogrammes.

Then the wood lost by accident or pruning may be estimated at a minimum of 5 kilogrammes.

The mineral composition of the wood must come near that given by the analyses hereabove indicated. As to the leaves analyzed, as they were still attached to the branches, they contain certainly more phosphoric acid and potash than the fallen leaves. In estimating the loss due to the leaves according to these analyses, a little overstatement will be found; but in the final result it will not amount to enough to note.

The olive tree producing yearly 30 litres of olives will therefore lose—

	Kilos.	Kilos.
In ashes—		
By its stalks	0.025.5	= 0.125
By its leaves	0.059.9	= 0.450
By its fruits	0.018.18	= 0.324
Total		0.899
In phosphoric acid—		
By its stalks	0.001.05	= 0.005
By its leaves	0.002.99	= 0.026
By its fruits	0.001.318	= 0.023
Total		0.054
And in potash—		
By its stalks	0.003.55	= 0.018
By its leaves	0.007.49	= 0.067
By its fruits	0.003.618	= 0.065
Total		0.150

As to nitrogen, according to Mr. de Gasparin, 100 kilogrammes of olives would contain 0.274, leaves 5 per 1,000; granting that the wood of the olive tree contains at least 1 per 100 of nitrogen, as the greatest part of other woods do, it will be found for the loss in nitrogen:

	Kilos.	Kilos.
By the stalks	0.000.5	= 0.050
By the leaves	0.005.9	= 0.046
By the fruits	0.002.7418	= 0.049
Total		0.145

Therefore the same calculation for 150 olive trees of same production contained in 1 hectare will give:

	Kilos.
In nitrogen	21.6
In potash	22.5
In phosphoric acid	8.1

It is seen by this discussion that the olive tree presents about the same consumption of necessary fertilizing principles as the vine. A part of its roots are spread out near the surface, the other penetrates

deeply when the subsoil is permeable. The olive tree then spreads out upon a cube of ground which may be sometimes very large. This explains how it finds, in the substances surrounding it and when left to itself, the conditions of existence for so long a time, how groves of olive trees may exist for thousands of years, and also how by culture, by a rational manuring, it is possible to assure the duration of that valuable tree and the abundance of its crops during a long period of centuries.

Knowing now the nature and the quantity of the elements drawn from the soil by the olive tree, it is well to look after their restitution by a good manure, the cost of which can be estimated from 100 to 120 francs per hectare.

In restoring all waste to the soil, the crop of the olive tree would not be exhausting it. The elements of oil are especially drawn from the atmosphere and water. What exhausts the soil is the enormous proportion of pulp, stones, wood, and leaves gathered with every crop without restoring the elements taken with them.

When the oil is extracted all residuum goes into industry without any thoughts for the soil which has supplied it. The olive husks, after complete pressing, feed the furnaces of the mills; the pulp is entirely lost, boughs from pruning are burned on the farms, nothing in short of what has composed the crop of the tree returns to the soil.

Agriculturists have for a long time had the custom of manuring almost exclusively with nitrogenous manure. In analyzing the composition and fertilizing value of the residuum of the olive tree, it would seem well to add some manures containing potash and phosphoric acid.

The following is the composition of the ashes of dead twigs coming from the pruning: Ashes of twigs of olive tree, per kilogramme, 270 grammes of coarse fragments (coal, earth, etc.). Per kilogramme of fine ashes: Potash, 55.780 grammes; phosphoric acid, 33.867 grammes. As shown above, Mr. Audoynaud having got per kilogramme of ashes potash 147 grammes, phosphoric acid 33 grammes, it can be concluded from the comparison of the two analyses that the potash disappears progressively in the vegetable organs in proportion as they come near their death.

This is now the composition of the residuum after the extraction of oil: Per kilogramme, water 763 grammes; dry substance, 237 grammes. Per kilogramme of dry substance, ashes 29.1 grammes; nitrogen, 22.2 grammes; potash, 0.3 grammes; phosphoric acid, 1.5 grammes.

According to these analyses the loss represented by not utilizing the ashes of the twigs is rather considerable in potash and phosphoric acid, and the residuum is worth nothing except for the nitrogen and for the organic matter capable of modifying advantageously the physical qualities of the soil. It must not be forgotten that this residuum contains always water and may conduce to maintain moisture at the foot of the trees. But the ashes of the twigs and the residuum are not the only losses

of the olive tree; the olive husks and the fallen leaves must be reckoned. Besides the soil must have its reserve of principle which can be supplied only by special manures as oil cakes, wool rags; they are manures containing nitrogen used periodically in careful culture. It would be well to add wood ashes not leached, sulphate of potash, and chloride of potassium. Finally to complete the restitution it is well to use either excrements or urine diluted in water, bone powder, or phosphate of lime, being manures with a phosphoric-acid base. In appropriating to the application of such manure a sum of 100 francs per hectare, say 75 centimes per tree of good growth, the rules of good culture are followed, and after a few years the soil is supplied again with all the principles extracted by a long series of crops.

Amongst the manures of domestic animals, one of the most active for the culture of olive trees is that from sheep. It is first class manure when phosphate is added. Also to be recommended as cheap and economical manures are: Wool rags, old leather, horsehair, hoofs, bones, and horn scraps.

FORMULÆ OF CHEMICAL MANURES.

The following are some practical formulæ for the composition of chemical manures, to be used for the manure of 1 hectare or of 150 olive trees of good growth:

(1) Applicable to a soil poor in nitrogen: Sulphate of ammonia, 150 kilos; superphosphate of lime at from 30° to 32°, 200 kilos; triturated sesame oil cakes, 6 to 7 per cent. of nitrogen, 400 kilos; unleached ashes, 200 kilos; total, 950 kilos, or, say, from 6 to 7 kilos per tree.

(2) Applicable to a soil poor in potash: Nitrate of potash at 95°, 150 kilos; mineral phosphate in bone powder, 200 kilos; triturated sesame oil cakes, 300 kilos; crude pulverized sulphate of lime, 200 kilos; total, 850 kilos, or, say, 5 to 6 kilos per tree.

(3) Applicable to a soil poor in phosphoric acid: Phosphate of lime at from 30° to 32°, 400 kilos; chloride of potassium, 100 kilos; triturated sesame cakes, 300 kilos; soot, 200 kilos; total, 1,000 kilos, or, say, 6.5 to 7 kilos per tree.

These formulæ can be altered according to the composition of the soil; that composition can be known either by analyses in the laboratory or by analyzing the soil by the trees themselves; that is to say, in dividing the plantation in five nearly equal parts—1, 2, 3, 4, 5—and in manuring No. 1 with a manure without nitrogen, No. 2 with one without potash, No. 3 with one without phosphoric acid, No. 4 with a complete manure, and No. 5 being left to stand as witness of the results These experiments require, to be useful, to be continued for 5 or 6 years at least, as the atmospheric circumstances have a notable influence on the fruitfulness of the olive tree; serious errors might follow if the experiments were made during 1 or 2 years only. For this reason the

direct analysis in the laboratory is to be preferred; it prevents the loss of time.

Circumstances which have influence on the nature of manures.—When plantations are in the vicinity of towns, near railways, or highways there is often an advantage to use town manures as excrements, industrial products, or dung coming from stables or cow houses in manuring frequently and in small quantities.

When they are far from populous centers and from railways or highways, the preference must be given to wool rags, old leather, horn scraps, horsehair, hoofs, bones, and sheep's manure in manuring abundantly every 4 or 5 years. Commercial chemical manures, as well as olive cakes, which with little weight contain a considerable quantity of useful substances, are also to be recommended when the carriage of the manure is expensive.

Manure with undried plants.—In the plantations far from highways, and of difficult access, the culture around the trees of plants of prompt growth, as broad beans, white lupinus, vetches, Madia sativa, etc., is useful; they are buried undried. They are not very nutritive, but as they take from the atmosphere the greatest part of their nourishment, they do not exhaust the soil of its mineral principles, and, therefore, return more than they take. Their physical influence is considerable; they disintegrate the ground and give to it more permeability; buried during the spring, they maintain, at the foot of the tree during the strong heats, a moisture much more advantageous than the waterings.

Composts.—It is not to be forgotten that the spontaneous vegetation of many untilled lands may abundantly supply plants which, after having been previously crushed by the feet of horses, can be put in water-tight pits, mixed with mold, straw fragments, leaves, lime, ashes, any part of dung or excrements produced on the farm, and give, after fermentation, a compost of a real value, worth much more than its cost price.

Time of manuring.—Manure of a slow decomposition, as wool rags, old leather, horn scraps, horsehair, hoofs, old rubbish, cow-house dung, and composts are advantageously spread in autumn. They receive then the rains of the winter, which facilitate their disintegration, check their fermentation, and render easier assimilation by the roots. The more these manures are disintegrated more is their action beneficial.

As to the very soluble manures, as excrements, dried night soil, poultry excrement, guano, and all commercial manures generally which contain much organic nitrogen, it is better to apply them in winter time.

Finally, the sulphate of ammonia, chloride of potassium, and especially nitrates, manures very soluble in water, are to be spread in preference during the first days of spring.

Mode of spreading manures.—Whatever their nature, manures must be buried over the whole extent of ground occupied by the roots. It

is known that the roots spread all the further from the foot of the tree as the soil is poorer and less deep. Theory as well as practice require, then, the spreading of the manures on a circle, the diameter of which equals the length of the longest horizontal branch of the tree.

The depth to be covered depends upon the nature of the manure. Commercial nitrogenized substances and chemical manures must be much divided, mixed previously with earth, and not deeply covered.

As to composts, wool rags, not decomposed manures, a circular ditch is dug about the tree, 30 or 40 centimeters deep, at a distance from its foot varying with the horizontal length of its branches; in this the manure is placed in layers 5 centimeters thick and covered with the earth taken from the ditch.

It is indispensable not to spread the wool rags in too thick layer, for if the spring was too dry a fermentation might supervene which would raise the temperature of the soil and injure the roots.

Time for manuring.—In considering a biennial crop, which is recommended for the advantage of the agriculturists, the manuring must take place in the course of the winter which precedes the year of production and directly after the pruning; the tree, cleared from its suckers and dead wood, receiving fully air and light, copiously manured, is put in a good condition for producing new wood which will be loaded with fruits the following year.

HARVESTING THE CROP.

The olive tree flowers every year, and there are those who advocate an attempt to gain a yearly crop; but the majority are content to try to get a good crop every two years. The trees bud in May and flower in June.

Olives to be preserved green are picked in September, those destined for oil from November until the following May; but the best results, to crop and tree, seem to follow harvesting near midwinter when the olive is black, though oil made from olives gathered as late as February and March is preferred for its keeping properties. The main reasons for early harvest seem to be that the insects have less chance to propagate, and that new shoots, which are to bear the fruit of the following year, have not started, and are thus safe from injury during harvest.

The farmers in this neighborhood, many of them, spread sheets under the trees and knock the fruit down with poles, injuring fruit and tree in so doing. It is a bad plan, made necessary by neglect of proper pruning.

The harvest is gathered largely by Italian women who come into France for that purpose; they are paid by the quantity gathered, boarding themselves.

OIL MANUFACTURE.

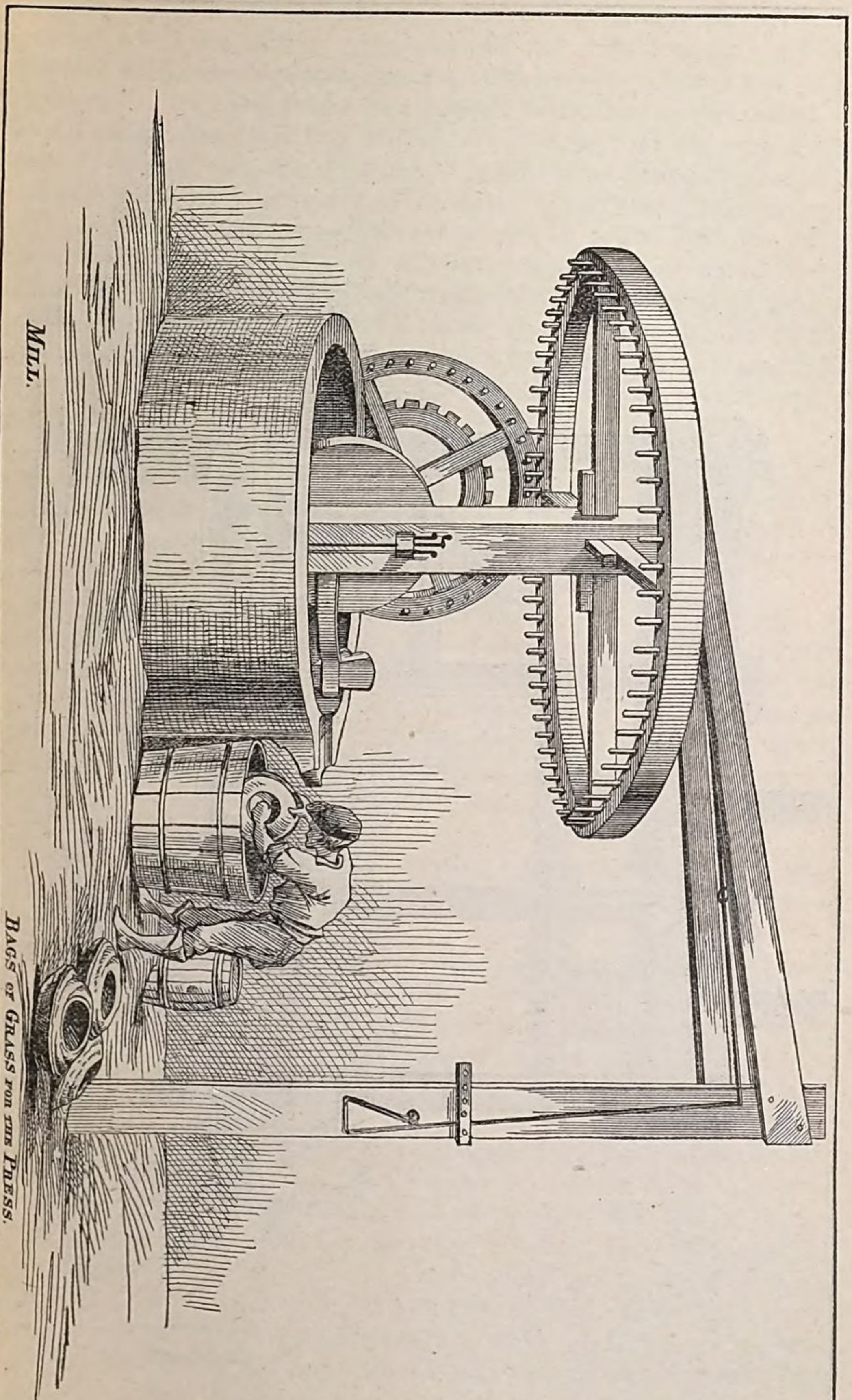
Oil mills.—The olives being gathered, the farmer here either takes them to the mill at once if he sells to the miller by weight, or spreads them in the sun or granary to dry out some of the moisture if they are simply to be ground by weight for his own benefit. The olive seems to lose no oil until the humidity is taken out; but water hot or cold, or still better, oil, must be added to olives too dry, to cause their oil to flow.

The mill in use to-day to crush the olives differs little from those used for centuries. I visited one near Nice early in November, when the crop was just beginning to arrive (see sketches of the mill); the olives were poured into an enormous stone bowl from the center of which rose a large wooden shaft crowned with a large wheel; in the rim of the wheel, pointed downwards and regularly spaced, were strong oak pegs for cogs; these met similar pegs or cogs in the power wheel, which was turned slowly by an overshot waterwheel; attached to the up right shaft, forming an acute angle with its lower end, was a large millstone exactly the shape of a large grindstone, the edge bevelled to match the slightly concave bottom of the great bowl; from the side of the upright shaft, opposite to the great millstone on the end of a short horizontal shaft, was a scraper which fitted the inner side of the bowl. When the mill starts the olives in the bottom of the bowl are crushed by the stone, those forced up the inner sides of the bowl as the great stone revolves, are scraped off and drop back under the stone until the mass is reduced to an oily paste; this paste shoveled out was packed into flattish-round woven-grass bags, which were taken to the presses; these are simply rough heavy frames fitted with large screw presses worked by hand; the bags are piled up in single piles, like so many cheeses, on the wide oak slab forming the bottom of the frame, the presses are screwed down upon them with a hand bar, exactly as our house-raising tacks are screwed up; the oil drains into tubs placed to receive it, when boiling water is poured over the bags to help the flow, and joins the oil in the tub; the oil rising to the surface of the water is skimmed off with very large tin skimmers.

Mr. Brullé, director of the agronomic station of Nice, has invented a mill which, as it crushes the pulp, extracts the stone and throws it out; this allows, according to Mr. Brullé and other authorities, the oil of the pulp, the true virgin oil, to be obtained from the press without any mixture of that from the stone or kernel.

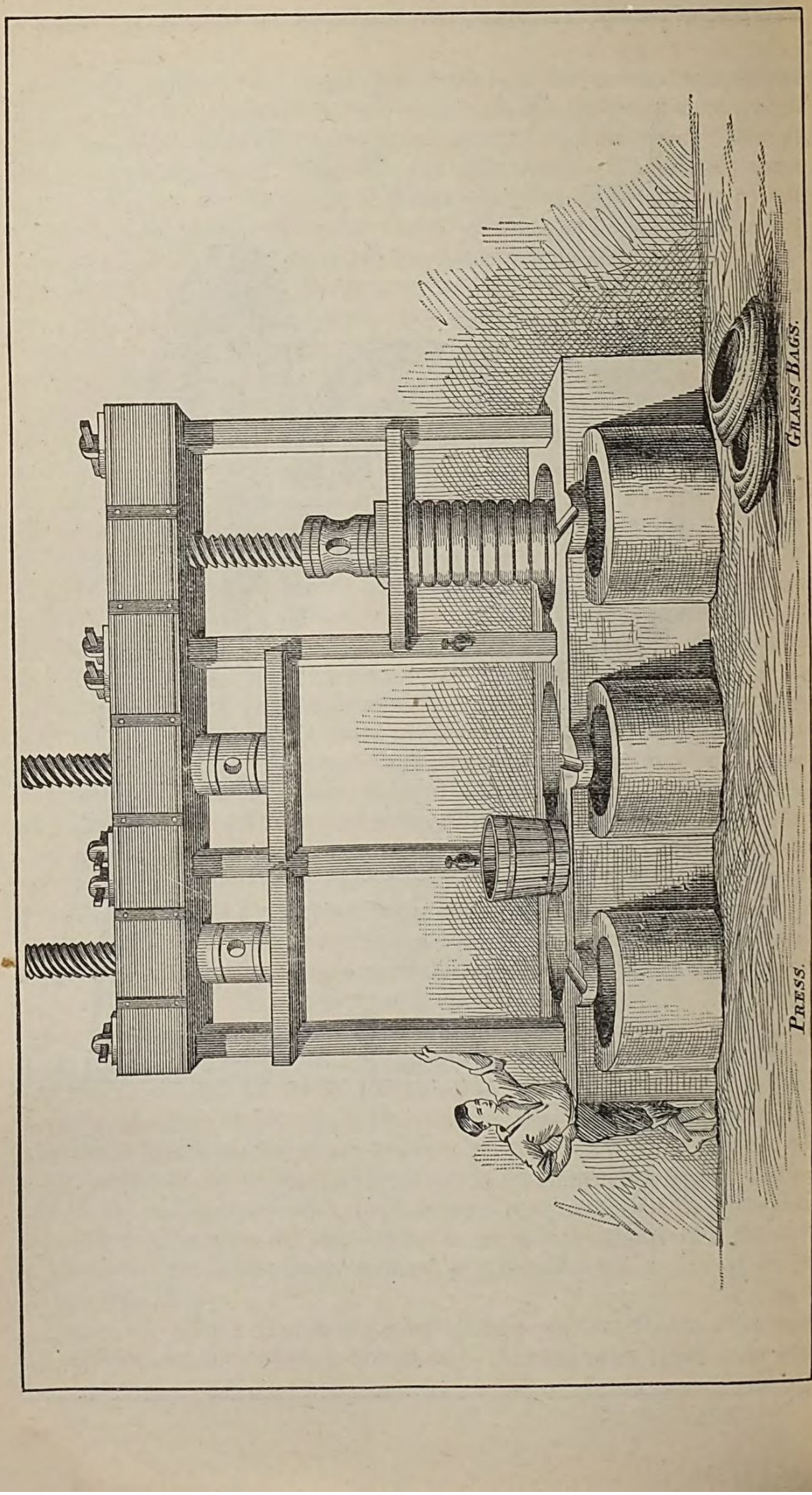
The people of these warm, olive-raising countries are slow to adopt new ideas, so Mr. Brullé will have to wait some time before seeing his new labor-saving (to say the least) invention supersede the clumsy, old-fashoined methods which are used now, because the ancestors of the people used them.

Virgin oil.—Many people talk about virgin oil, but such a thing can not be found by the ordinary consumer. It requires so much care and



Mill.

Bags of Grass for the Press.


GLASS BAGS.
PRESS.

attention to prepare this oil that it is only to be found in the house of a farmer who has a mill and prepares this oil for his own use. Olives are taken when only three-quarters ripe; these are all selected free from any blemish; they are taken immediately after they are gathered to the mill where they are but slightly crushed, so that the pulp alone comes in contact with the millstone; the seed must not be touched, for though the kernel contains a certain quantity of oil, it is, as connoisseurs know, rather acid and has not as fine a taste as the oil from the pulp. This pulp having been crushed without the addition of water, either hot or cold, is gathered in a heap, the center of which is made hollow in the shape of a funnel. The oil flows by itself from the inner sides into the center of the reservoir, from which it is taken with a large ladle. The oil so prepared is greenish in color, its perfume is exquisite and it can be kept for many years.

First quality oil.—For oil of the first quality, called "cannon oil," the olives are placed in the mill without addition of water if the fruit is freshly gathered. The oily paste is placed in bags made of clean esparto, and submitted to the press. In mills with more modern improvements hydraulic presses are used.

Second-quality oil.—To obtain oil of the second quality, and in order to extract from the pulp all the oil which it contains, they throw the contents of the bags into a vat which is full of cold or warm water; the whole is well stirred up, the broken fragments of the seeds fall to the bottom, while the pulp floats, this is gathered and replaced under the press. Some pour boiling water over the bags the first time they are put under the press; this simplifies the labor, greatly increases the yield, but reduces the quality.

After all the usual means of extracting oil from the pulp have been employed, 10 per cent. of oil can still be obtained by using bisulphide of carbon.

Oil yield.—The best oil is undoubtedly obtained from olives not fully ripe, for too ripe fruit gives oil which is heavy and without perfume. Risso says that 100 kilogrammes of sufficiently ripe and sound olives ought, in a good year, to yield 20 kilogrammes of good oil and 4 kilogrammes of inferior quality, and in bad years only 10 of good oil and 2 of inferior.

Olive refuse.—After the oil is extracted the skins and refuse are employed in heating boilers, the muddy substance found at the bottom of the most inferior quality of oil is used as manure, and last of all the broken stones or "grignons" make a very excellent fuel, which has the advantage of not giving off any carbonic-acid gas as charcoal does. Fraud is found in the oil mills, as everywhere else. Should the olives be moldy, which often happens when they have been gathered or kept in bad condition, the bad taste is hidden by adding leaves of wild olive trees to the pulp. Others even go so far as to throw seed oils over the pulp while it is being ground, so as to get a perfect blending with the new oil

Keeping oil.—To keep oil in good condition needs great care and attention; the clear oil ought to be separated from the turbid at once, for the longer the oil remains on the lees the more apt it is to contract a rancid or a bad odor. When the oil has been decanted several times, as the needs may be, filtered through dry moss, carded cotton, sand, plaster, charcoal, etc., it must be stored in a place which is sheltered both in summer from the heat, and in winter from the cold.

Restoration.—Oil must be kept in vessels, which close tightly, and are made of a substance on which oil has no action; these precautions are indispensable, for the effect of the air on oils is too well known not to be guarded against; they absorb oxygen very rapidly and soon reach a condition which renders them unfit for food. They can be restored nearly to their original state by warming them with the addition of alcohol and washing them afterward, but they become much paler in color, without any strong taste or odor. Limewater in equal proportions can also be used, or 25 centigrammes of caustic potash per kilogramme of oil.

The best way to obtain a lighter color in very dark oils is to mix them with oils which are nearly white.

Oils when exposed to the cold become congealed; a gentle heat will restore them to their original state. On the surface of congealed oils is found an essential oil, which is employed on the pivots of watches by watchmakers.

Proving the oil.—Mr. Brullé, the director of the agricultural station at Nice, has, during the past 2 years, perfected two methods of proving the purity of olive oil as well as the quantity and kind of oil used in adulteration. The first process is a quantitative analysis of which the following is a translation:

PROCESS BY ILLUMINATED NITRIC ACID.

The process consists in submitting the suspected oil to the action of nitrous vapors produced by the action of nitric acid upon dry albumen.

(The cubic centimeter equals a gramme of distilled water.)

Operation.—Take a test tube, put in it 0.1 gramme of albumen powdered, 2 cubic centimeters of nitric acid and 10 cubic centimeters of the oil to be tested; heat gently over the alcohol lamp so that acid and oil keep the same temperature. When the acid boils, incline the tube over the flame in such a way that by the ebullition albumen and oil may be thoroughly mixed; this will be accomplished when a movement of particles is apparent facilitating the dissolving of the particles of albumen which give off shining vapors as they dissolve.

If the oil analyzed is pure olive oil, the color of the mixture is pale yellow with a greenish tinge, while olive oils adulterated with seed oils, (even 5 per cent.), take a clear yellow color which varies from pale golden yellow to orange, and even to red, according to the oil used in adulterating.

To get the best results, after having examined the mixture in its heated state, plunge the test tube into ice water, and in about 2 minutes examine again. When the contents are congealed the traces of the oxidization of the mixture by the nitrous vapors upon the inner side of the tube are more apparent.

The reaction of Mr. Brullé is very sensitive; it permits to detect as little as 5 per cent. of cotton-seed oil in the olive oil; with 5 per cent. of cotton-seed oil the color of the mixture will correspond exactly to 100 parts water, 5 units of Naples yellow, and 5 units of dark chrome.

Given prepared samples of oil with exact amount of adulteration known, it is easy to decide the amount of adulteration in any sample offered with the help of this reaction.

As the proportion of adulterating oil increases, the colors become more intense. Fifty per cent. of cotton-seed oil would give a precipitate of a color to correspond with 100 parts water, 5 units Naples yellow, 5 units chrome yellow, and 5 units of vermilion.

It is to be noted that when other oils, such as sesamum, are joined with the cotton-seed oil in an adulteration, the fraud is as easily detected, but not the amount of cotton-seed oil, as the sesamum oil tends to change the vermilion red to deep orange.

The following mixtures of pure olive oil and 10 per cent. of adulterating oils gave the following results: Olive oil, pale yellow greenish tinge; olive oil, 10 per cent. cotton, vermilion red; olive oil, 10 per cent. groundnut, golden yellow; olive oil, 10 per cent. sesamum, golden yellow, pale; olive oil, 10 per cent. beechnut, dark red; olive oil, 10 per cent. poppy seed, golden yellow pale; olive oil, 10 per cent. nut, yellow orange; olive oil, 10 per cent. cotton and sesamum, dark orange; olive oil, 10 per cent. cotton and groundnut, golden yellow, bright. The observer, by comparison, will readily detect 5 per cent. of adulteration by any of these oils.

SECOND PROCESS.

QUALITATIVE ANALYSIS.

Process based upon the curious effects produced by nitrate of silver upon oil.

Operation.—Treat 10 cubic centimeters of oil with 5 cubic centimeters of nitric acid in a porcelain capsule, heating and shaking thoroughly at the same time until it foams. Different colors are obtained according to the oil used. We pay no attention to this, but letting the capsule cool, we add 5 cubic centimeters of a solution of nitrate of silver (25 per cent.) with alcohol of 90°.

If we continue the heat, then comes a moment, at about 115° C., where the nitrate of silver is suddenly decomposed and deposits the metallic silver upon the inner sides of the capsule. The heat is continued far enough to cause the first luster to disappear, and on tapping

the capsule lightly, we observe on the one hand on the inner sides the color of the thin oily coating, on the other the metallic luster playing on the surface of the liquid. To tell then whether the oil is pure or adulterated we turn to the following table:

Oils.	Colors (natural state).	
	Oily coating.	Metallic luster.
Olive	Olive green	Green.
Cotton	Green	Ash green.
Sesamum	Chrome green	Sevres blue.
Groundnut	Greenish yellow	Emerald green.
Poppyseed	Olive green	Green, light blue.
Camelina	Persian lake	Light blue.
Flaxseed	Dragon's blood	Emerald green.
Rape seed	Persian lake	Cyprus green.

Second operation.—Examination by saponification of the oils. It sometimes happens that by the first operation the kind of oil used in adulterating is not clear; in that case proceed to saponify the mixture.

For this purpose 20 grammes of an alcoholic preparation of caustic potash is dissolved in a larger quantity of 90 per cent. alcohol, not, however, exceeding 100 cubic centimeters. Add 20 cubic centimeters of this solution in a test tube to 10 cubic centimeters of the oil to be tested, shake thoroughly, and heat in a water bath to 92° C., leaving it in the water 20 minutes. Empty the contents of the tube into a porcelain capsule holding say half liter; fill it with boiling water, adding 50 cubic centimeters of a 20 per cent. solution of sulphuric acid.

After shaking decant the acidified water, again add boiling water until, after several decantations, the last traces of sulphuric acid have gone.

Treat the oil thus obtained by the first operation to get a different set of colors as per the following table:

Oils.	Colors (saponified).	
	Oily coating.	Metallic luster.
Olive	Orange of Mars	Cyprus green.
Cotton	Sienna	Cobalt violet.
Sesamum	Golden yellow	Do.
Groundnut	Persian Lake	Light violet.
Poppy seed	Golden ochre	Blue.
Camelina	Dark chrome	Do.
Flaxseed	Black	Green.
Rape seed	Burnt carmine	Ultramarine blue.

In these tables the names of colors are those of water colors, which are the same everywhere.

PRESERVING.

According to location the olives for preserving are generally gathered by hand when they are still green, in September or October, depending on the locality; they are thrown into tubs which are full of water

and in which a certain quantity of soda of salicornia has been dissolved. The salicornia and "salsola" of the Chenopodiaceæ family grow naturally on the Mediterranean coast. When burnt their ashes contain a great quantity of excellent soda, which is used in glass and soap manufactories. These plants can be sown on lands that have been overrun by the sea so as to absorb all the soda the sea has left on the soil. The olives are left in this bath 3 or 4 days, when they soften and at the same time are pickled; then they are placed in small casks with water, salt, and aromatic herbs. The olive is ready for eating when the stone is easily separated from the fruit. Another way to preserve them is to pour over the olives water with ordinary ashes rendered caustic by the addition of a little quicklime; after staying some days in this mixture they are placed in other tubs of clean water, which is changed frequently; to this water is added muriate of soda and aromatic herbs.

When the olives to be preserved are quite ripe the blackest and finest are chosen and exposed to the sun for several days, salt is sprinkled over them, and they are then put in oil.

There are some varieties of olives which when perfectly ripe can be eaten as they are in their natural state.

The olive tree, evergreen, bears its fruit on the wood of the preceding year, and never twice at the same place; sprouts readily from the trunk and becomes a vigorous tree. With rational pruning it gives a regular, abundant, and early crop.

PRUNING.

In regard to pruning, I can not do better than draw largely on Mr. Gos, who seems to agree with the majority of authorities. He says:

"Pruning is most important and requisite; it regulates the production of fruit and improves its quality, making it larger sized and the crop more abundant. The opinions of the agriculturists as to pruning do not agree; some maintain that the olive tree must be sparingly pruned, as it is the small boughs which bear fruit; some say that it wants a vigorous pruning, as it bears its fruit only on the new wood, and that to have new wood it is necessary to prune vigorously; others think that every variety wants a distinct system of pruning. All these opinions have no serious basis, and generally come from special cases. What occasions those differences of opinion is that in practice three distinct cases are present, viz:

(A) Trees never having been pruned.

(B) Trees not having been pruned for a long time.

(C) Trees having always been regularly pruned.

The system of pruning being unchanged, the method of application only is different, and it is well to examine closely the operations necessitated by the above three cases, two of them being, as regard culture, pathological cases, the last one only being a normal case, on which it is possible to study methodically the pruning that the olive tree requires.

(A) Trees never having been pruned: Those trees are of course full of wood; they have many confused branches, few boughs lower down, and very picturesque form, not at all favorable for the production of fruit. In these conditions some abundant crops may be obtained, but they are very irregular; further, the tree is a complicated mass of exhausted branchlets, which are the shelter of numerous parasites. To bring these trees to a regular production some agriculturists would, prune radically, leaving only the stem and the principal branches, but it would be better to pull up the trees or not to prune them at all than to have them submitted to such amputation.

When one wishes to submit an olive tree which has never been pruned to a rational pruning it is well to proceed gradually, and to avoid revolutionary prunings, because in years of dryness or of severe cold the greater part of the trees might be destroyed.

The best method of pruning is as follows:

Cut off the top at a distance from the ground equal to the greatest diameter of the tree; although the sacrifice of the tops is often distressing it must be done, and the branches cut off will soon be succeeded by new ones more productive and in better form.

Clear the inside of the tree, suppress the vertical branches which follow the direction of the stem, take off the dead wood and all that hinders the climbing of the pickers into the tree; let every leafy part receive air and light, which are indispensable to good fructification; suppress the branches too close as well as the unhealthy ones, or those which have not sufficient room to grow; clear the shoots about the tree, spare the branches which hang towards the ground as the branches of the weeping willow do.

This pruning will not bring fruit in the same year; more often it is not until the fourth year that the tree bears fruit; during that time and every spring it will be well to nip off the shoots which would have a tendency to rise above the new top, and during the summer prevent the growth of any suckers, which pruning encourages.

Five or six years after the application of the above pruning the olive tree gets again a regular production, and its fruit is larger sized, earlier, more abundant, and less accessible to parasites; in fact the tree has passed from a wild to a domestic state, and will have to be pruned as the trees having always been regularly pruned.

(B) Trees not having been pruned for a long time. The first needful operation in such plantations is the clearing up of the trees; they generally are too close to each other, and therefore want air and light; their roots steal nourishment from each other, and a multitude of parasites live on their drooping branches; one out of three, sometimes two out of three, must be dug up; the trees left will be in better condition and can be easily brought into good order. After the clearing up, all dead or unhealthy branches are to be cut off, so the tree will live easily, its nutrition not be hindered, and it can have room to spread. After these

two operations the trees will have to be pruned as those having always been regularly pruned.

(C) Trees having always been regularly pruned. The aim of the pruning is:

First, to give to the tree an agreeable shape in accordance with the laws of production of the fruit.

Second, to draw to the extremity of each twig and leaflet the sap which circulates in the plant.

Third, to get large-sized, savory, and early fruits.

Fourth, to save the tree from the dry winds and the rays of the sun.

These aims can not be reached by an irrational pruning; the physiology of the tree must first be studied. Amongst the fruit-bearing trees, some, as the vine, bear their fruit on the wood of the year, some, as the pear and apple tree, bear their fruit only on the old wood; finally there is found, in olive and peach trees in particular, a form of intermediate vegetation. Mr. Riondet says on this head:

> A branchlet appears this year and is covered with fruit next year; the part which has given flowers and fruit will not again do so, but it can grow for some years until it is fully exhausted and be succeeded by a new branchlet, which grows at its base. The pruning of the peach tree, based on the principle of the annual substitution of a new branchlet on the old one, was brought to remarkable perfection in the environs of Paris and especially at Montreuil; any form you may desire can be given to the peach tree, and, in the hands of a skilled gardener, all branches stand every year completely filled with flowers and fruit. The branchlets of the preceding year blossom and bear fruit; but a careful nipping prevents their becoming wood boughs, and brings forward the formation of a new branchlet for the following year; in this way the peach tree is always provided with new boughs and may, during many years, give regular and abundant crops.

The olive tree has just the same form of vegetation as the peach tree, with the sole difference that it easily puts forth new branchlets on its old wood, and this is sufficient to explain the short life of the uncultivated peach tree, while the olive tree is almost imperishable. It is well always to bear in mind that the olive tree blossoms only on the wood of the preceding year, but that it can, always and from all sides, put forth new branchlets.

After having applied the common principles of pruning, sharp pruning on the side of the strongest growth, light pruning and vertical cutting on the weaker side to preserve proper proportion among the branches, after having hindered the spreading of the suckers, and after having suppressed them when some have sprouted; after having cleansed the interior of the tree by clearing it of the too abundant shoots, and thus secured the free circulation of air and the action of the sun in all parts of the tree, it is not good to apply the radical pruning spoken of above.

Mr. Riondet says:

> The pruning of the olive tree is only the clearing of the tree of the branchlets which, after having grown during several years, and after having successively borne fruit on all parts, begin to be exhausted and to dry up.

The trees are to be pruned after the crop; they put forth then new branchlets which, the following year, will give flowers and fruit; in the course of spring and summer the shoots are to be cut off and the vertical branches of the top nipped off if possible. Is the olive tree to be pruned often? A yearly pruning will give a yearly crop; after the crop (the fruit being as much as possible picked by hand and not knocked down with a pole) all boughs which have borne fruit are to be nipped; new branchlets will grow, but this will not hinder the tree ripening its fruit; a well-cultivated and well-manured tree may have at the same time the power of giving nourishment to the fruit grown on the branchlets of the preceding year and of producing new branchlets, or of letting the old ones grow longer to prepare the crop of the following year. However, a biennial pruning is to be preferred; it is true that it only brings a biennial crop; but it has for effect the suppressing, one year out of two (as we shall see further), of the means of existence of the most destroying parasite of the tree, the Dacus oleæ. Furthermore, even if that parasite did not exist, it would be rational and especially economical to have one year destined to the production of wood and the following year to the production of fruit.

What is the shape to be given to the olive trees? The goblet shape is the most simple and the easiest to be formed and kept up; it is applicable to all varieties of trees; it allows air, light, and heat to circulate among the branches, reduces the work of pruning and facilitates the gathering; where the trees have a tendency to grow too large, it is well when they are young to commence the goblet form in order to maintain proper proportions.

Lower and drooping branches must not be cut off, as they give fruit abundantly when they receive air and sunlight; to cut them off would be a loss, for the lowest parts of the tree are the most fruitful, more easily reached at harvest time.

Proper means to regulate the production of the olive trees.—The trees being well tilled, no other plants cultivated between the rows, a careful pruning of the older twigs after the harvest every two years should be sufficient to keep them in vigorous bearing.

Recapitulation in the order of questions supplied by the State Department:

1. The verdale and lucques are suggested among many for preserving.

2. The cailletier and nirvana are probably as good as any for oil.

3. Names and descriptions are given on sheets 2 and 3 of manuscript.

4. The trees above mentioned are grown within a hundred miles of the sea, and from the shore to at least 2,000 feet above the sea level, on hilly and rolling ground, exposed to the southern sun where possible.

5. The questions of climatic influence were quite fully treated in the portion of the report devoted to oranges and lemons.

6. There is no regular system of irrigation.

7. Cultivation by hoe or plow several times a year. Sheet 3 of manuscript.

8. Vigorous pruning beneficial; keep the tree low and of goblet shape. Sheets 25–28 of manuscript.

9. Harvest for oil is gathered from November to May. The earlier the better. For pickling green, in September or October. Sheets 16–25 of manuscript.

10. Trees begin to fruit at from 4 to 5 years.

11. Average yield per tree may be placed at 30 quarts. Sheet 9 of manuscript.

12. Trees should be planted 40 to 50 feet apart. Sheet 3 of manuscript.

13. The tree is propagated as any common fruit tree. Sheet 3 of manuscript.

15. See Bibliography.

16. For account of all the latest researches on insects see the portion of report on the Enemies and Friends of the Tree. The chief malady, the "Morpée," was minutely described in the portion of report referring to oranges. **(See Fruit Culture in Foreign Countries.)**

ENEMIES OF THE OLIVE TREE.

There is no tree known to have more enemies than the olive; they attack the wood, the blossom, the leaves, and the fruit.

These foes do not include the cold and the fogs, both of which are very injurious to this sensitive plant; great drought and warm winds are also detrimental to its welfare. The olive tree has to bear the attacks of certain mammifers, certain small birds, and insects of nearly every description.

(1) Mammifers.

In certain localities young trees must be guarded against the teeth of rabbits and against cattle. The field mice (*Mus sylvaticus*), are great consumers of olives; but as they only attack fallen fruit, which ought to be considered as unfit for oil, I consider them as very trifling culprits.

(2) Birds.

Among birds of medium size there are some which feed on the olive itself; these are the thrush (*Turdus musicus*), the black bird (*Turdus merula*), the starling (*Sturnus vulgaris*), the magpie (*Pica melanoleuca*); others feed on the almond or kernel; the *Coccothraustes vulgaris*, and the *Loxia curvirostra*. One can say that birds in general are foud of olives; but as the appetite of the smaller kinds, such as the warbler, the robin red breast, figeaters, the wren, etc., is very quickly satisfied, and as they devour a much greater quantity of insects than fruit, one should class them among the friends of the olive tree.

The thrush and the black bird consume a very large quantity of olives; there are certain parts of the country in autumn where these birds literally swarm; they seek among the olive trees their resting-place for the night, and before roosting they partake of their evening meal; this operation they do not perform in silence, far from it, for from far away one can hear their noisy chatter; it is to these birds that we are indebted for the wild olive tree which grows in the forests; they are therefore of some utility; but can this be compared to the enormous damage they do? I do not think so; therefore the farmer who comes with his gun to disturb the feast of these devastators can not be blamed.

The *Coccothraustes vulgaris* and the *Loxia curvirostra*, which must not be confounded one with the other, both belong to the families of

sparrows and conirostres. Both are birds of passage, which rest wherever they find abundant food; they emigrate towards the Mediterranean about the month of November; they are heavy stubby birds of the size of a large sparrow; they have great strength in their claws and in their beaks; they use them for opening pine cones and the stones of other fruits so as to get at the kernel; both these birds are prejudicial to the olive harvest in this sense, that they attack the fruit in order to get at the stone, out of which they extract the kernel; the *Coccothraustes vulgaris* specially is very wasteful, for every olive which he may eat he plucks fifty; therefore one can not declare too severe war against them; they are easily distinguished from other birds by their size and by their call, which is not very shrill.

The starling ravages the olive trees that are in the neighborhood of marshes. Lastly, the magpie, which is almost unknown in the Alpes Maritimes, eats olives wherever found.

(3) Insects.

I have said before that the olive tree has to fear nearly all insects; among the Hymenoptera, the ants (*Cremastogaster scutellaris* and *Camponotus pubescens*). Among the Coleoptera, *Phlœotribus oleæ*, or Neïron; *Hylasinus fraxini; Cionus fraxini; Peritelus Schœnherri*, and *Cremissi; Othiorhynchur meridionalis; Ghilianii* and *oleæ; Apion galactitis*, and others of the same species, etc. Among the Neuroptera: The *Termite Calotermas flavicollis.* Among the Hemiptera: *Phlœothrips oleæ* of Targioni (or black worm or Barban); *Euphyllura oleæ* or *Psylla oleæ*, and several cochineals (*Lecanium oleæ, Aspidiotus villosus, Mytilaspis flava, Pollinia costæ, Philippia follicularis*), etc.

Among the Lepidoptera: *Pray's oleellus* or miner caterpillar is really dangerous; *Margarodes unionalis*, the caterpillar of which is dangerous for shoots and for the graftings; *Zelleria, oleastrella Boarmia umbrasia, Metrocampa honoraria.* These three last species attack more particularly the wild olive trees.

Among the Diptera: *Dacus oleæ*, or Keïron. The list is a long one; I shall start with the

Hymenoptera Ants.

(1) *Cremastogaster scutellaris.*—I had at first, after reading Laure, placed that ant essentially southern among the friends of the olive-trees, but since arguing the point very seriously with two of my colleagues of the entomological society, I have been forced to alter my opinion, and obliged to bring down this insect from the pedestal on which I was disposed to let it remain.

One of these colleagues was kind enough to give me a description of the *Cremastogaster scutellaris* taken from nature; I will now render his account, which I am, to my great regret, obliged to curtail:

The head of the male insect is round and short; the mandibles are large; the maxillary palpi are of 5 articulations; labial palpi of 3; antennæ of 12; the thorax is rather compressed; it is armed with two thorns, which diverge a little; the first articulation of the petiole is flat; the second is nodiform and hollow above a longitudinal groove, rather deep, which divides it in two parts; the abdomen is united to the petiole, not by its fore side as in most of the other ants, but by its antero, superior part, which is nearly heart-shaped; generally this insect is black and the head bright-red, the leg brownish red; sometimes the thorax and the petioles are also red; length 3 to 5 milimetres.

These cremastogasters advance in a file along the olive trees, carob trees, and other trees. Laure says that they are in search of the scars that the Dacus has made in the olives in order to deposit its eggs; the former is hunting for these eggs. It is certain that this ant has an object in wandering over the trunk and leaves of the olive tree; but it is not at all proved that these insects are any help against the invasions of the Dacus, for the female of this dipteran, when depositing her eggs in the olive, makes an insignificant wound in the fruit, and the larva is too deeply sunken in the latter for it to be possible to be got at by the ant. The cremastogaster could, if it were in any way carnivorous, attack the fly when, still weak, it leaves the olive.

It is far more likely that they are hunting for cochineals peculiar to the olive trees, not to destroy them, but to utilize them for their own benefit. This is what this insect does, according to the opinion of Mr. Ernest André, who has made a special study of the ant: The *Cremastogaster scutellaris*, says he, is far from frequenting specially the olive tree; it is found on other trees of entirely different natures; its object is to look for the plant-louse and the cochineals, of which it delights to suck the liquid dejections. The case described by Laure is void of any foundation, and quite contrary to what is known about the habits of the ant.

The visits which the cremastogaster pays to the wounded olives are simply to suck the juice which may by chance run out, for it is proved that the ant cannot mastigate its food.

One of my colleagues goes further and says that the ants not only furrow galleries under the bark of trees which are detrimental to them, but carry their love for the plant-louse and the cochineal so far as to pick them up from the soil where they may have fallen accidentally, and carry them back to the tree where they find their food.

It is therefore useful to look after the nests of the cremastogaster under the trees or under their bark, and to destroy them when found.

(2) *Camponotus pubescens.*—It is a large black ant which abounds on the trees attacked by the Morfée; this insect evidently comes to lick the Lecanium oleas. The camponotus seems to live in good understanding with the cremastogaster.

COLEOPTERA.

(1) *Chlosotribus oleæ.*—This insect is a Coleopter, of the ravaging family of the Xylophagans, and is known in these regions by the local names of Neïroun, Neïron, Courcoussoun, Babarotte, Charençon; in Italy it goes by the name of *Tunteruolo dell'olivo.* This is its scientific description: Length, 2 millimetres; of blackish tint, covered with a greyish down; the head is indented; the mandibles are projecting; the face is flattened and finely dotted; the antennæ are in proportionate length with the size of the insect; the last articulation is divided in three leaves of unequal size, having the shape of a rake, of reddish tint, and bristled with hairs of a special type, showing their connection with the great family of Lamellicorus; the body is convex, narrower in the fore part than the hind, round on the sides; clytra convex, very dotted, ornamented with 10 very prominent striæ, bristling with red hairs; the body is thick set; the legs are brown. The Phlœotribus has under its elytra membranous wings which it uses readily. This insect is considered after the Dacus or Keïron, of which I will speak later, the most injurious insect to the olive harvest. It attacks the tree itself while the Keïron attacks only the fruit. It not only does harm to the tree by injuring and weakening its fruit-producing branches, but by the shelter which its abandoned holes give to the Phlœothrips or black worm, in which the latter deposits its eggs and where it goes through its various transformations; therefore every one ought to do all that is possible to destroy them entirely.

In 1826 Professor Risso mentions, without giving any detail, an insect which he denominates "*Cionus destructor;*" it seems to me to be the same *Phlœotribus oleæ.* In 1843 the engineer Bertrand mentions three insects which must have some analogy with the Phlœotribus; the Scarabee of the olive-tree which attacks only dead wood, which seems to be the "Apate sex-dentata," of which I will not say anything now; the "Bostriche," which is the Hylesinus; and lastly the "Vrillette" of the olive tree, which seems to me to be no other than the Phlœotribus for the very reason of the characteristic division of the enlargement of its antennæ in three branches. The author adds that the larva nourishes itself on the alburnum of the tree and lives on the small branches which it kills. In 1848 Bompar of Draguignan gives more ample details than his predecessors; he exposes the errors made by Amouroux and Bernard, and makes mistakes himself by stating that the Phlœotribus is born and lives on the olive tree, that it rarely flies, and that it feeds rather on the dry wood of the olive tree than on its young and tender shoots. He even goes so far as to say that it might very well originate from the sap when in fermentation in the wood separated from the tree, and ends by putting this singular question: "Is the germ ambient?"

Dr. Martineng, of Grasse, published in 1863 and 1864 two reports on

the Neïron, in which he gives a summary of the very judicious remarks of Mr. Bernard, proprietor at Chateauneuf. I have read with a great deal of care Mr. Martineng's notes and have compared his with mine and have arrived at the conclusion that Mr. Bertrand was correct, and what great service his observations might have been to the agriculturists had they only been followed! The following is an analysis of the reports of Dr. Martineng showing wherein our observations differ:

There is not a single olive farmer who does not know, or who has not observed that small insect, the size of a millet seed, which measures but 1 millimetre from its head to its abdomen, burrowing to deposit its eggs under the bark of the branches which have been cut off in pruning at the end of the winter or early spring. These branches are in a very short time pierced all over with small holes, rendered noticeable by a yellowish dust, which is thrown out by the insect while establishing its interior galleries.

Mr. Martineng continues: The branches preferred by the Neïron are those of medium size, where the bark is soft and thick and preserves for a longer time than the smaller ones moisture sufficient for the development of the eggs. It is easy to observe that the eggs deposited in too small branches do not mature.

It has been noticed that the insect only attacks the branches which have been pruned between January and July, for branches cut off after this period and placed in the same conditions as those pruned in the spring are not covered with Neïron.

That observation, which in my opinion is open to discussion, has certainly one use, viz, to show the advantage or disadvantage of keeping the branches which have been cut off anywhere near the olive-tree plantations, also what is the proper period for pruning the trees.

Messrs. Bernard and Martineng divide the existence of the Neiron in two very distinct phases, the laying of the eggs in the newly-cut branches and the damages caused to the tree itself. It gnaws the soft bark that surrounds the young shoots which bear the next year's harvest, and very often perforates through and through the young branches; it seems to select the angle formed by two shoots, choosing generally the part opposed to the direction of the rain and avoiding the north exposure; its galleries are not deep and it abandons them willingly to go and form others in the vicinity.

The Neïron lives all the year round on the olive tree, except at the time of laying its eggs, in the boughs cut off in pruning. This operation begins at the end of the winter and lasts 45 to 50 days, sometimes till the month of June. It is very likely that the parents die as soon as they have secured a shelter for their progeny.

Mr. Bertrand was of opinion that the female insect produced the larva directly itself, but Mr. Martineng has corrected this error.

It is useless to explain at length that the female Phlœotribus, being fecundated, deposits its eggs in small recesses, often very numerous, which both insects, male and female, have excavated in the galleries they have tunneled, and that these eggs are covered over with the dust of the wood, which they resemble in color and size. It is for this reason that they have escaped Mr. Bernard's observation.

One can see, adds Mr. Martineng, the young larva start, on leaving its birth place, to perforate the branch in its length, piercing galleries in a line more or less perpendicular to those made by its parents. By the middle of July all larvæ have changed into Neïrons, and one only finds in the branches either dead or imperfect larvæ.

As soon as the insect is perfect it perforates the bark from within, escapes to the trees, and commences its ravages.

Are these ravages real? Can they be attributed to the Neïron? Messrs. Bertrand and Martineng say so, and I, for my part, certify that I have observed them many times and have shown their work to many agriculturists, who only notice the loss of their olives year by year due to the Keïron or Dacus, but take no measures to protect their trees from this real danger threatening them.

It is the Neïron, continues Mr. Martineng, which undermines the young shoots and causes them to dry up and fall. Does this insect lay its eggs on the live tree? That point has not yet been solved, adds the doctor.

Nearly all authors seem to agree that there is only one generation of Phlœotribus oleæ per annum, and that that generation takes birth exclusively on the wood that has been cut down; hundreds of these insects have died in my glass cases after having lived in them for weeks, and after having caused very visible damage to the young olive branches placed with them. As I said, these insects died without sexual connection, and therefore without having prepared a second generation. In my observations I have not noticed on the branches of young trees the trace of secondary galleries indicating the work of the larva; we can not perhaps conclude from this that the insect hatched in June or July and which has gone through its different metamorphoses in 50 or 60 days, only remains until the following spring before satisfying the laws of procreation. Bernard, Campanio, Bompar, and others admit of several annual generations, and the following I translate from the "Annales d'Agriculture" of Florence, published in 1879. It is the most thoughtful and recent document which I have found on this subject:

The honorable Baron G. Ricasoli sent in 1877 from Valdarno and from the province of Sienna, to the entomological society of Florence, and this society also received in 1878 (April 20) of the agricultural meeting of Perouse, young olive branches in which were confined a few female insects of the first generation of the *Phlœotribus oleæ* (*Puntevuolo dell olivo*), engaged in perforating their galleries and in depositing the eggs of their summer generation, so fatal to the branches that bear blossom, and so preparing for a third and fourth generation to create havoc in the harvest of the following year.

There can, therefore, be in the course of a year several generations of Phlœotribus oleæ, either in the wood that has been cut off or on the branches which have been attacked on the tree. This would show the necessity of fighting against the most important of these generations, the best proven in my opinion, the one found on the wood cut off in pruning which we have at hand, and which offers us a way, if not of destroying the enemy completely, at least of reducing its numbers materially.

Mr. Companio, of Perpignan, is the only one to my knowledge who has spoken of a parasite of Phlœotribus oleæ, which he describes under the name of Locusta arachnoïda (arachnoid grasshopper), and of which he gives a rather singular illustration; it is possible that in the "Pyrenées Orientales" the Phlœotribus has a parasite, or rather an enemy; but though I have made numerous researches I have failed to find anything similar in these regions.

From what I have said it is certain that when the pruning season comes, viz, the end of the winter or in the spring, one must separate in two lots the cut wood of medium size and the small branches, which must contain more or less Phlœotrips, Cochineals, Psylles, of which I will speak later; these ought to be burnt at once, and the larger branches and limbs, which must be thoroughly investigated so as to find out whether the Neïron has attacked them. Twenty days after, when one can have sure proof that the larva is living and working, the best thing is to burn all this wood that has served as a trap, or if one wishes to keep the wood, one ought to singe it well and take off the bark, or to leave it for several days under water, then dry it and place same in a dry place, hermetically closed, and as far as possible from any olive plantation. If the limbs cut off be burned, it is advisable to do so at night, as in so doing one has a chance of destroying many moths and Tineidæ which are detrimental to the olive tree.

As for the wood which is cut from July to the winter, the small branches particularly are full of living Phlœotribus and Hylesinus, many Phlœotrips and caterpillars also, and must be burned immediately; but one can use the larger wood which does not, at this time of the year, serve as nests; it is nevertheless advisable to look it over from time to time should it be in vicinity of any olive plantation. Personally I should like this wood treated in the way above mentioned.

Mr. Martineng, who arrived at conclusions very similar to my own, ends his report by a remark made by Mr. Funel de Clausonne, chairman of the Society of Agriculture of Nice:

> Many persons, says Mr. Funel de Clausonne, appear surprised to see the Neïron leave the living tree to attack the branch which has been separated from it. The Neïron lays its eggs in the spring when the trees are turgid with sap. It could not work and lay its microscopic eggs in the living bark where the current of sap was in constant motion ascending and descending.

The damage caused by the Neïron to the olive trees was known imperfectly by the mayor of Pelissanne, for in 1857 this magistrate, acting in accordance with the laws of 1831 and 1837, made decree in order to fight the ravages caused by the insect named by him "Barbarotte." He ordered the immediate removal of all cut wood into a far-away shed, or the same to be burnt. This measure, though incomplete, showed, it is said, very good results.

In 1878 the Society of Agriculture of Nice gave, in its pamphlet entitled "The wood of the olive tree," excellent advice to the oil farmers.

I have one objection to make; that is, they recommend the immediate removal of the wood which has been cut off; by leaving for 20 days or so the heavier wood where it fell, the purpose in my opinion would be better attained.

The *Phlœotribus oleæ* or Neïron is therefore a coleopteran, a relation of the weevils, it is true, but belonging to the family of the Xylophagans, while the Thrips, or Phlœothrips, called in these regions black worm, or "Barban," is a Hemipter Thysanopter; they are insects of size, shape, nature, and habits essentially different; their only similitude is their propensity to injure the olive trees.

Hylesinus fraxini.—The *Hylesinus fraxini* seems not to be very well known by agriculturists in general, who mistakes it for the Phlœotribus, or Neïron. It has been little studied by authors who have wrongly described its mode of living and the damages it causes to the olive tree.

It is said that this coleopteran causes its ravages while still in the state of larva, that the female whilst pregnant chooses a branch upon which it deposits its progeny, which can be detected by reddish or greenish-gray spots which appear where the attack has taken place. My observations, on the contrary, show that the Hylesinus behaves in a manner very similar in every way to the Phlœotribus. It is at the end of the winter or early spring that the Hylesinus follows the Phlœotribus onto the cut wood; like the latter, it operates in couples; but while the Phlœotribus attacks the medium-sized branches, the Hylesinus chooses the heavy wood as being more fit to protect its larva, and makes its hole generally in the rough parts, more often near the spot where the previous year a branch has been cut off, where the wood is dead. The couple or pair work in a manner identical to that of the Phlœotribus and deposit, like it, their eggs in cells arranged along galleries; the larva works lengthways of the wood; when matured into a perfect insect it regains the living tree, where it forms galleries, which have not a very great depth, and chooses the spot where the young branches are attached to the tree, thus causing their decay.

The Hylesinus fraxini is less thick-set than the Phlœotribus, less dark and more varied in color; its elytra are longer than their width and have 6 striæ. Its principal distinction from the Phlœotribus is that its size is double that of the other, and that its antennæ, instead of being terminated in three unequal branches like a rake, are ended by a mace in the shape of a heart. The larva is in proportion for size with the insect; it is curled in half circle, larger in the fore than after part, apodal, whity and regularly wrinkled, while that of the Phlocotribus is much smaller in size, deformed, irregular, and with a large head.

The ways of destroying this insect are the same as those recommended for the Phlœotribus, and as this insect chooses from preference the rough and dead parts it is advisable to cut off as far as possible these refuges from the living tree; therefore, in keeping not only the trunk but the

branches in a very clean state one will be able to destroy a great quantity, not only of Phlœotribus and Hylesinus, but also of Phlœothrips; of this latter I will speak later on.

The result of my observations is that the Hylesinus is to the Phlœotribus in number and proportion as 1 is to 10; but as it is twice the size of the latter, and as its wounds to the living tree are in proportion to its size, it may be considered as very injurious.

Cionus fraxini.—The olive tree has still in the family of Coleoptera another enemy all the more dangerous as it only attacks the shoots which would bear fruit, the young trees, and the grafts, which it rapidly strips of their leaves.

I was able to study all the transformations of a curculionida which in the state of a perfect insect, as well as when a larva, caused in 1865 and 1866 in Nice and its neighborhood real injury to the young olive trees. This insect, which was the Cionus fraxini, appears in April after having most likely spent the winter under the bark, and deposits its eggs on the leaves of the shoots, or of the young trees.

The larva is yellowish, sticky, attacks the white of the leaf, the under part, which it eats in irregular spots without touching the bright green surface.

After 10 or 12 days this larva has attained its full maturity; it selects a leaf and, uniting under itself the two extremities of its body, forms itself into a ball, loses its yellowish tint, its stickiness, turns to a gray color, then white, dries up and becomes transparent. After 24 hours one can only notice a perfectly oval-shaped shell, in which the larva, deprived of its coat, spins freely; one can see it (with the assistance of its mandibles) thickening, rounding, and polishing its abode, which takes an amber tint; it has accomplished these transformations by coating its body with a slimy substance which is excreted by a retractable nipple situated on the upper part of the terminal segment of its abdomen; this substance allows the insect to attach itself to the leaves or to protect itself from the rain or sun. When in the state of a nymph it takes a rest, and prepares itself for its last transformation, which takes 8 or 10 days; then the insect perforates its shell with the aid of its rostrum, cutting an exactly spherical segment.

Then the Cionus spreads on the leaves, which it devours in the same way as the larva, or on the edges; they pair, then fly to the summit of young trees, which they prefer. Here is the scientific description of the *Cionus fraxini:* Centennæ, tawny; proboscis, or trunk, cylindrical and curved, brown at its basis, black at extremity; head, grayish-brown, with the upper part blackish; corselet narrower than the elytra, of a brownish-gray, with upper part blackish; elytra of a whity gray, with small striæ not very distinct, dotted with brown and gray; sometimes there is a large black spot alike on both elytra, which extends from the base to the center; under part of the body covered with dark-gray scales; feet tawny; thighs dentated on the under side.

The male is smaller than the female, its rostrum is shorter; the markings on the elytra vary much in both sexes; as soon as hatched they seek one another and commence mating, which is not the habit of the Phlœotribus nor the *Hylesinus fraxini.*

It is in its perfect insect state that this one of the curculionidæ causes the most damage; its appetite not only leads it to devour the leaves upon which it walks from end to end, making a mark a millimetre wide, but it digs its rostrum into the soft and tender shoots, which are full of sap, making wounds which infallibly cause the loss of both flower and fruit which their shoots were to bear. I have noticed that from April till the end of July there might be two seasons of laying, and that the first was always deposited on the young shoots or grafts; the best way I can suggest to fight against this enemy is to shake the young shoots over an open umbrella, reversed so that by the shaking the insect would fall in the receptacle thus prepared; the leaves could also be examined, when it is easy to detect the larva in the act of preparing its abode for the purpose of its various transformations. The larvæ of the Cionus fraxini are attacked by several species of Hymenoptera; the larva, stung by the Hymenopter, depositary of its enemy's egg, continues its existence and becomes food for the parasites, which transform themselves into a small chrysalis, of a metallic black color, admirable in shape. Of 10 cocoons, 5 have given birth to Hymenoptera.

Peritelus Schœnherri.—This coleopteran belongs essentially to the south ,and is of the family of the Curculionidæ; it attacks the young shoots, in the center of which it settles itself; its transformations take place in the ground, and it is most likely also in the earth that its larva finds its food, either on the roots of the olive tree or of some other plants. The fact is that I never found this larva on the tree, but in May the perfect insect is often found on the young shoots which wither under its attacks. The *Peritelus schœnherri* is a pretty insect, silvery gray, of slender form, and is in size a little larger than the Cionus. The following is its scientific description:

The case of the prothorax and elytra cut square (this is the distinctive sign of the species); shield-shaped spot dark; size regular, about 5 to 6 millimeters long; color, silvery gray, with sometimes a yellow or bronze hue, which forms a darker longitudinal band upon the elytra; rostrum short, as long as the head; antennæ gray, pubescent, oval, terminated in a point; prothorax cylindrical, slightly depressed on the upper side; elytra slender, oval, cut square at the case, terminating in a point, nearly flat on the back, convex toward the end, which turns down; striæ fine distinctly dotted; legs small; forelegs ending in hooks rounded on outer edge; female slightly convex underneath.

The relative large size of this insect, its silvery color striking against the tender green of the shoots make its capture easy; it can be caught by hand or by shaking young shoots and grafts over an open umbrella.

Peritelus cremieri, more numerous than the preceding, like it, but smaller, plumper, less silvery; rostrum thick and a little longer than the

head. *Othiorhynchus ghilianii* (Fairmaire) and *Othiorhynchus Oleæ* are mentioned as hurtful to the olive in Italy; but they have not been seen in the south of France.

Othiorhynchus meridionalis.—Bompart mentions the *Othiorhynchus meridionalis* as injurious to the olive tree. The head is long in shape, antennæ elbowed, body black and hard; at Toulon it bears the name of "chaplum." This insect is nocturnal, performs its different transformations at the foot of the tree, and feeds on the leaves and young wood; it must be looked for in the daytime at the foot of the tree; it abounds at Flyères, but is less commonly found in the Alpes Maritimes.

Oryctes grypus.—Another Coleopteran of strong build, the *Oryctes grypus*, of the family of the Lamellicorns, called by Bompart Rhinoceros or Engraitto galinos, is harmless when it has become perfect; the only time it may be (for it has been proven) injurious to the olive tree is when it is in the state of larva; for being deposited amongst the roots it may gnaw them. The way to fight against this insect is to spread soot at the foot of the trees, which at the same time acts as manure, or in burying oil lees, which are a deadly poison to insects.

Vesperus strepens.—This insect is sometimes accused of injuring the roots of the olive trees when in a state of larva, but the fact needs proof, although the perfect insect is often found on the olive trees.

CANTHARIS VESICATORIA (Linnéu).

Bompart classes the Cantharis amongst the insects which are injurious to the olive tree. He says that it attacks the leaves in April and May. It is not to be wondered at that the Cantharis seeks the olive tree when it can not find any ash or lilac trees, which are its natural food and of the same botanical family. This insect, in my opinion, is not a very serious enemy of the olive tree.

Companyo, of Perpignon, speaks of a *Vesperus sex-pustulatus* of the family of Longicorns, which lives in olive wood; as it appears that this insect is very rare, it can not be very dangerous.

The same would be the fact concerning the *Agrpnus carbonarius* of the family of the Elateridæ, which is black, velvety, speckled with silvery white spots. This insect is also mentioned by Compayno.

NEUROPTERA.

Colotermes flavicolis—One of my colleagues of Amelie les Bains informed me that he had discovered a termite (is it the *Colotermes flavicolis?*) reducing to dust the trunks of olive trees which though old still showed signs of life. As the olive tree still gives a crop even when it appears only to have its bark left, it is of the highest importance to destroy this insect, which though it attacks the dead parts of the tree is certainly not without injury to the living wood.

The means to be employed for its destruction are boiling water and fire, only both remedies must be applied with great care.

HEMIPTERA.

Phlœothrips oleæ (Targioni) *Thrips oleæ* (Costa.)

My chapter on the thrips was ready when I first learned of a series of reports by Haliday, who, struck by the marked characteristics of these insects, has considered them as forming a particular order, and has denominated them Thysanoptera, which he has divided into two families; the Tubulifers and the Terebrantes. Our black Hemiptera homoptera will therefore be a *Thysanopter tubulifer*, as it has a borer in the shape of a tube, and we ourselves will call it *Phlœothrips oleæ*, name which Targioni has given it.

This being established, we will continue our original undertaking.

In 1826 Risso spoke of a black Staphylinus (*Staphylinus lugubris*), which might very well be our Phlœothrips of the olive tree.

In 1834 Passerini published in Florence a memoir, in which he states that he had found thrips in their different transformations on the olive-tree leaves in the neighborhood of Pietrasanta; he also noticed that many buds contained from 4 to 5 eggs, that the larvae were fixed to the under part of the leaves, in order to take their nourishment from their parenchyma. Then from the spring to the autumn many generations saw life. To this Hemiptera the learned Italian had given the name of *Thrip phaœsaphus* (Linneus).

In 1846 Mazzarosa, in a book which he published on agriculture in general in the providence of Lucques, says that at the beginning of the century many olive trees of the locality were infested from May to August by thrips which caused great havoc amongst the young fruit and leaves. Over 6,000 trees were affected by this scourge; the damage done was so enormous that the terror stricken agriculturists abandoned the trees which were affected; some nevertheless tried remedies, principally pruning, from which process they derived some benefit.

In 1848 Bompar, of Draguignan, who is the first French naturalist who has spoken at any length of a thrips without however designating its species, considers it as an enemy of the olive tree.

He is of opinion that this insect lays eggs twice a year, in April and in September, at the summit of the shoots at the top of the tree in the small holes which have been made by the Phlœotripus or Neïron, or in those it perforates for itself. This Hemiptera caused great ravages in 1603, 1820, 1836, in the neighborhood of Draguignan. The thrips, adds Bompar, finds its nourishment in the sugar or sap of tender leaves or buds, which it literally perforates with thousands of small holes. The trees that are thus attacked only give fruit on the lower branches. The largest part of the harm is in June, July, and August. In 1863 and 1864 Dr. Martineng, of Grasse, gives far more precise indications on this insect. The thrips, which is called black worm in the district of Grasse, and Barban on the left bank of the Var, lives during the winter months under the bark and the dead leaves, but chooses in preference the gal-

leries abandoned by the Neïron, and selects those that are the most sheltered.

During the fine season this insect circulates on the trunk and on the leaves; the female makes use of the galleries made by the Nüroun and deposits its eggs in them; it is proved that this insect attacks the young fruit, and the farmers believe that it poisons all with which it has had any contact. I have gathered a few of these insects from Falicon and the Mantega localities which unfortunately are attacked; this has placed me in a position to study, describe, and sketch them. My description which follows agrees with that of the Italian Naturalist Targioni Tozzetti: Length, 2 to 3 millimeters. The body is all a brilliant pitch black, has six legs; the head is as wide as deep, rounded in the forepart, eyes large, with facets; antennæ have 9 articulations and are as long as half the length of the body, inserted on the front of the head, the first and last articulations black, the others pitch color, on the last articulation a few black hairs; the prothorax is nearly hexagonal; 4 membraneous wings are attached very high on the shoulders and are fixed two by two folding themselves on the body so as to reach beyond the abdomen; these wings are very transparent, reddish, narrow, rounded at their extremities, garnished with long, black hairs; each wing resembles a feather; the legs are black and short; it has two tarses, one terminated by an air hole thickly garnished with fine hairs; both are armed with hooks; the abdomen is black, has 9 segments dark pitch color on the junction of the rings; it is terminated in both sexes by a tube or borer garnished with hairs at its extremity. I do not know what distinction there is between the male and female. This insect, before reaching the perfect state described above, undergoes two transformations which are characterized by a lighter color and the absence of wings.

Among the remedies used against these insects are whitewashing the trunk and larger branches, fumigation of tobacco and sulphur, washes of boiling water, and plenty of manure to strengthen the growth; but as the evil is generally on some one tree, or even parts of a tree, the most effective means of combating it is vigorous pruning, with the precaution of burning all the leaves and branches pruned, not forgetting to keep the tree in good condition.

FALSE PUCERONS.

Psylla—Euphyllura oleæ (Foerster, 1848), called Araneum by Pliny, Bumbacella Ragnatella in Italy, Pulgilla in Spain.

I give here the description given by B. de Fonscolombe of this insect, which he calls false puceron or cotton of the flowers:

Its larva, says this learned naturalist, produces the cotton which surrounds the olive bloom, and hides itself under this cotton which it has secreted; the perfect insect appears in July, and then frequents the olive tree, either for its food or for the purpose of laying its eggs, while the larva and its nest appear when the buds begin to

develop; the false Puceron in its full maturity is only the length of one line; its color is a greenish yellow; its forehead, prominent and flat, has the shape of a shield; the antennæ are longer than the head, filiform at extremities; the corselet is transversal and very narrow; the elytra are nearly square, widening at the outside of the base, and are rounded at their extremities, white and of a clouded transparency, spotted here and there with reddish stains, with two black points in centre of inner side; the wings are white and transparent; the abdomen is conical; the anus of the female appears to be armed with two long united triangular blades, which must assist her in laying or placing its eggs; the trunk lies along the breast; the legs are rather thick; the thighs are enlarged to club shape, to enable the insect to jump.

The larvæ and nymphæ resemble, with the exception of the wings, the perfect insect, but they are of a paler green.

The description of the insect in its perfect state is correct, but that of the larvæ and nymphæ is not so satisfactory; besides, nothing is said of the habits of the Euphyllura. Mr. Bernard, the engineer, as early as 1848, says it is a false Puceron, resembling very much a small grasshopper, which attacks in great numbers the twigs and stems of the leaves, producing a loss of sap injurious to the tree. Its length is one line, with four transparent wings; antennæ are filiform; the proboscis is visible, the abdomen greenish, terminating in a point; yellowish legs; very seldom flies; if disturbed it walks sideways, and jumps with grea ease. They gather in company at the axilla of the leaves and round the petiole, under a cottony covering which Pliny calls a cobweb. It secretes from the anus a honey-like substance, sweet-tasting, which gathers in drops, and which might very well be the Elsomeli of the ancients.

Bompar, in his account of the false Pucerons, says that they are very small insects, with large heads, stumpy bodies, protruding eyes. The larva, he says, has six legs. They lay twice a year—once in April, then in September. This insect attacks the young shoots, which it very soon destroys. It is called "Sauteret" (Tumper) at Grasse, because of its facility in jumping, and Blanquet (Whitey) in Toulon, because of the color of its wrapper. Since 1848 many people have studied this interesting family of insects. It has been shown that the larva has two phases in its existence, and that the nympha had all the activity of the perfect insect, with the exception of jumping and flying.

These are my own observations: The larvæ and nymphæ move about under a cottony covering which is milky white and a little shiny at its basis; the perfect insect keeps away from this substance, which it secretes no more. If the inhabitants of this white abode are in any way disturbed, one sees bristly white balls exit with precipitation and crawl along the branches; freeing these living balls of some of their outer covering matter, one easily distinguishes thick-set larvæ of a yellow-red tint, with thick, black antennæ; the body is flat shield shape and carried by six slender legs with black extremities. No apparent sign of elytra; the body is covered with long white threads of great tenuity; at the extremity of the body there is an apparatus of a darker

tint from which escape lumps of cotton; in the midst of the larvæ is found drops of a slimy liquid which has been produced by them.

So much for the larvæ; as for the nympha, it resembles already the perfect insect in shape, and specially in its greenish color; it has less cotton about it than the larva; but still has the apparatus which terminates the abdomen; on each side of the thorax can be noticed rudiments of elytra of a brownish red, very short, and standing out from the body; the nympha, like the larva, lifts its abdomen in moving forward. Independently of the abundant sweating which the Psylla causes with its proboscis, says Bompar, it must, to a certain extent, injure the clusters of fruit; besides, as the flowers are surrounded by a slimy substance, they grow with difficulty, and dampness and dew gather about and cling to them.

The agriculturists are glad to have a moderate wind blowing during the blooming season, so that it may carry away the cotton left by the psylla and free the flowers.

The olive trees should be examined and the flowers and young fruit which show signs of the invasion be burned. This operation offers no difficulty, as the branches attacked are generally those nearest the ground. When the flower has fallen and the fruit grown the psylla spins its cotton lower on the tree at the axilla of young leaves, especially on young shoots or grafts. They can be detected under their white covering, perforating holes which must be detrimental to the growth of the tree. There is a small green spider, marked with black lines, which kills quantities of the false pucerons.

COCHINEALS.

Lecanium oleæ; Aspidiotus villosus; Mytilaspis flava; Pollinia costæ; Philippia follicularis.

One can safely say that if the cochineals have been utilized by industry they are generally detrimental to agriculture; that is to say, that nearly every species of trees harbors several species, which by their number, their frightful fecundity, and their incessant voracity exhaust the plants on which they live.

In the south of France, where the cochineals abound, says Mr. Signoret, many kinds of trees, amongst them olive, orange, and fig, are covered with black, which, on examination, proves to be a fungoid growth called "Fumagine," growing on coatings of the dejection of Coccus and Lecanium, seriously injuring the tree. Of all trees the olive tree is preferred by the cochineals of different species, amongst which can be mentioned: The *Lecanium oleæ* (Bernard-Signoret); the *Aspidiotus villosus* (Targioni); the *Mytilaspis flava* (Targioni); the *Pollinia costæ* (Targioni); the *Philippia oleæ* (Costa). The characteristic and general distinction of the cochineals is the nonexistence of a beak or rostrum in the male and the absence of wings or elytra in the female.

Lecanium oleæ (Bernard).—This cochineal is detrimental to the olive tree, not only by absorbing the saccharine substances of the young shoots and leaves, but also by the result of the spread of these saccharine matters, or by its excretions, which give rise to the birth of a cryptogamous plant, which is no other than the "Morphee" or "Fumagine," of which I shall speak later.

This insect is particular to the olive tree, and is even sometimes in such abundance that it invades the surrounding trees. The *Lecanium oleæ*, says Mr. Signoret, is rough, of a blackish brown, sometimes of a yellowish gray, has the shape of a rounded oval, rather pointed towards its extremity; its antennæ are large and have eight articulations.

The embryonic larva has only six articulations to the antennæ. The male of the *Lecanium oleæ* has never been discovered. At the period of laying, the female, then the size of a lentil, of a brownish red, places itself on a branch, contracts itself into a convex shape, and gives birth to more than 1,000 eggs; there are two layings a year. This cochineal was the object of a notice by Mr. Pablo Colvei; he called it the *Aspidiotus oleæ.* His notice was published in Madrid in 1880, in an edition with engravings.

Colonel Goureau, in his work published in 1859 on injurious insects, already at that date spoke of a cochineal, called by him *Coccus oleæ.* It is said in this work that this gall insect, real plague in the Var, was not known at Aix, and does not alarm Provence to any degree. All agree as to the part played by the said cochineal, which infects certain olive trees and exhausts them by constant stings, which cause an injurious loss of sap; this sap, with the very abundant dejections of the insect itself, facilitates the growth of "Morfee" or "Fumagine." The following species of cochineals are also found on the olive trees, but are not as injurious as the one above:

Aspidiotus villosus (Targioni).—This species was discovered by Targioni on the olive trees of Florence. He has only described the female, which is gray, covered with hairs, and of a cottony substance. The male, according to Mr. Signoret, is a yellowish red.

Mytilaspis flava (Targioni).—This cochineal is found mixed up with the *Pollinia costæ*, with which it must not be confounded; the female is covered with a gray dust, which renders its detection difficult, as it is the same color as the bark of the tree. The last segment presents five thread plates. The male is smaller and nearly yellow.

Pollinia costæ (Targioni).—Color, yellowish brown; shape, a rounded oval covered by a thick film formed by a whity secretion, more or less regular, which adheres quite firmly to the tree; but in which the insect is perfectly free.

These small masses, says Mr. Signoret, are sometimes aglomerated in a considerable heap resembling a white exudation of the sap of the tree; this cochineal was plentiful in Cannes on the olive shoots in 1870; it has no legs and rudimentary antennæ; the male is long, the abdomen large, the head wider than long; antennæ have nine articulations.

Philippia follicularis (Targioni), *Oleæ* (Costa).—This species forms a white bag, very voluminous, which is secreted by the female and deposited on the under part of the leaves; the antennæ have six articulations in all its transformations; the body is covered by a multitude of small hairs, the dorsal part particularly. Male unknown.

No other way is known for their destruction than to give plenty of vigor to the tree, keep it from constant moisture, kill the cochineals and destroy their nests with injections or lotions of water and vinegar or petroleum.

LEPIDOPTERA.

Certain Lepidoptera or butterflies can also be classed amongst the enemies of the olive tree.

Here are two reports sent in 1837 by Mr. B. de Fonscolombe to the French Entomological Society. The author says that there are two Tineidæ particularly injurious to the olive tree; one attacks the leaves and the other the fruit.

Tinea oleella (B. de Fonscolombe). *Chenille mineuse* (Dray's oleellus).—A small caterpillar with sixteen legs of a greenish brown, with black jaw, black scaly plate on back of neck, and another on the last rings of the body; has no hairs, yellow head, causes heavy damage in the Var and the County of Nice. It is seen in winter working between the two thicknesses of the leaves, or in March, towards the end of its existence, wrapping itself up in a few silk threads between the shoots and young branches along the tenderest twigs. This caterpillar, two lines long, transforms itself towards April into a chrysalis of oblong shape, the color of which is a yellowish green; it is found amongst the silky threads I have just mentioned, or in the cracks of the branches; the butterfly comes to light about the end of April; its wings are wrapped round its body; its antennæ are filiform, nearly as long as the insect itself; its trunk is small, its head scaly, its body of an ashy gray; its wings are long, marbled with black tints; the abdomen is yellow, with grey hairs, which forms a tuft towards the arms; its antennæ and legs are gray, the latter are armed with a spear which facilitates the jumping.

Tinea olivella (B. de F.).—This caterpillar lodges itself in the kernel of the olive in the same way as others do in the apples, cherries, etc. The egg which produces it must be deposited by the female on the blossom when the fruit is forming itself. It penetrates in the stone, which is still tender, and lives there until the time for its transformation has arrived, in September, when it perforates the stone at its only vulnerable spot; that is, where the fruit is attached to the stalk; then issuing from the fruit, it lets itself drop on the ground, where it undergoes its transformations. The fruit thus pierced falls at the least wind. This caterpillar is larger than the Tinea oleella; the chrysalis is yellow, the wings coverings a little brownish. The insect which comes out of it resembles very much the first described. This one, however, is larger. Bernard, of Marseilles, in his memoirs of 1872, thought there was only one species, which lived in the stone in the first generation, and on the leaves in the second.

B. de Fonscolombe combats this opinion on account of the characteristic difference of the two caterpillars, and on the impossibility of admitting that the same insect should feed itself on the mealy and at the same time oily substance of the kernel and on the cellular tissue of the leaf. Anyhow, many learned men, amongst whom are Duponchel,

Millière, and Stainton, who all have carefully studied the question of microlepidoptera, have come to the conclusion, notwithstanding the many reasons to believe the contrary, that there only exists one sole and same insect which they call the *Pray's oleellus*. Stainton, an English lepidopterist, has given satisfactory evidence that the two species were one and the same. B. de Fonscolombe, too, 14 years after his statement as above, admits of his error in his circular to the Entomological Society of France of 1851.

I can certify that the result of the breeding of the caterpillars that I obtained either from fallen fruit, from leaves or young sprouts in March and April, was that I obtained the same Tineidæ color iron grey, wings rolled up. I can also certify that amongst the numerous caterpillars which come out of stones, the largest, the deepest in color (wine lees tint), transformed themselves immediately; but that the smallest and youngest ones did not in any way hesitate to feed upon the olive tree leaves that I gave them.

There is, therefore, only one same and identical species of these caterpillars having annually two generations in different circumstances and conditions, observation which is very interesting to study. The caterpillar is greenish, spotted here and there on the back, with stains, color of wine lees; the chrysalis is either green or brownish yellow; the butterfly, which sees light in September, is iron grey with fringed wings, the upper ones being spotted with black, the under ones plain.

Coming to the means of destroying this insect, B. de Fonscolombe shows with reason that in Provence, where the trees are small, it is easy to detect and burn the leaves which are attacked by their yellowish brown irregular spots, which harbor the caterpillar; but this process of detection becomes far more difficult in the Var., and especially in the Alpes Maritimes, where the olive tree attains such large dimensions. Good advice to the oil cultivators is to light up at night large fires in the olive gardens in March, August, September, and October; any amount of Tineidæ, will come and burn themselves in the flame; another way is to stretch out at night time ropes coated with honey; the best way, however, is to frequently turn over the soil at the foot of the olive trees and not to let the fallen olives lie in September, for nearly all these olives have been detached from the tree by the work of the boring caterpillar, which has eaten away the base of the stalk so as to escape from the fruit and reach the ground, where it undergoes its transformations; these olives should be picked up before they dry, and as they do not yet contain sufficient oil to be used advantageously, the best thing to do with them is to burn or destroy them immediately. One can easily see what would result from leaving them by placing a few handfuls of the olives, showing the work of the insects in a bag; after one night quiet, large numbers of the caterpillars will have come out and can be seen making, on the inner sides of the sack, light cocoons in which to shelter their chrysalis.

Margarodes unionalis.—This pyralis deposits its whitish eggs at the axilla of the smaller branches; they are hatched 15 or 20 days after. The young caterpillar attacks the inferior part of the leaves at night-time; in the daytime they shelter themselves between two leaves that they have united by means of threads. The Margarodes take 5 or 6 weeks to develop itself, then it retires into the crevices of the bark where it undergoes its transformations.

The butterfly, which measures $0^{m}.0025$ to 0.0027^{m}, has white antennæ, large silky white transparent wings, without lines, of a pure white, iridescent in the newly born, the upper ones have the sides of a reddish brown; the thorax and abdomen are white; the female is larger than the male.

This is the only specimen which we possess in Europe of this remarkable and numerous species. The unionalis is plentiful in Provence, specially at Cannes, where it attacks particularly the olive and jasmine trees.

Lelleria oleastrella (Millière).—Caterpillar of a spindle shape, of a green, more or less dark, with longitudinal lines; the head, testaceous, is yellow. It lives on the *olea europosa*, but principally on the non-grafted tree; it attacks the new leaves, on which it settles and eats their under-parts; after its third molting it retires into a spun tunnel in the crevices of the bark which it only leaves at night to feed; its liveliness is remarkable. The chrysalis is of a brownish red; the hatching takes place a fortnight after the metamorphosis. Dimensions $0^{m}.0021$ to 0.0022^{m}; the upper wings of the butterfly are long, narrow, rectangular, and of an earthly appearance like the thorax and abdomen; the under wings are darkish gray, shining and garnished with long silky gray fringes; antennæ are filiform, brown, as long as the body; the head is white, the eyes are large and black; it can be caught at night, but not easily.

Boarmia umbraria (Millière).—The shape of the caterpillar of this species is cylindrical, of a brownish gray; it may be mistaken for the Rhomboidaria. It falls plentifully in the sheets that are spread under the trees when they are shaken for the harvest in February and March. The perfect insect is very noticeable. The male and female differ only by their size; in the female the antennæ are comb-shape. It has two hatchings a year, one in June and another in September. The caterpillar is quite common, the butterfly rare; the latter is sometimes taken at night with a light. This insect is not very dangerous to the olive tree, for it attacks only the old leaves of the large trees.

Metrocampa honoraria.—The caterpillar of this species shows on each of its middle segments a sort of projecting ring of a whitey-gray tint, varying from a violet to a reddish hue; it has twelve legs, eleven segments; frequents the olive tree, on which it takes its winter quarters stretched along its branches; it falls in the sheets at the time of harvesting when the trees are shaken. The chrysalis is a reddish brown. It is hatched in May and October, and is very prolific. The female is

larger than the male. The butterfly, flesh-colored, comes readily to the light; it is one of the largest of European Phalæna. It is also found on oak trees.

Acherontia atropos.—The caterpillar, which has two hatchings, one in April, the other in September, lives on the *Lycium barbarum* and *Europæum*, the *Datura stramonium*, the *Ligustrum vulgare*, and the *Tasminium fructicans;* it has also been found on the *Quercus robur.*

Sphynx ligustri.—The caterpillar lives from July to September on the privet, the lilac, and the pink laurel; it can therefore also live on the olive tree, which is of the same botanical family. Anyhow both the caterpillars of these two butterflies are too large not to be detected, their habits being, too, to settle on the lower branches in reach of eye and hand.

DIPTERANS.

Dacus oleæ (Latr.).—Of all the enemies of the olive tree the one that principally occupies the minds of cultivators at present is a fly called scientifically the *Dacus oleæ*, and for immemorial times bears the names of Gueïron, Keïroun, or Keïron, given it by the cultivators of the olive tree.

The *Dacus oleæ* is an insect of the Dipterans family, which is characterized by the existence of two wings, having behind them two other wings, movable, rudimentary, and useless for flight; they are called balancers.

The Dipterans have for a mouth a sucker composed of many scaly pieces, which are inclosed in a sort of trunk.

Blanchard has divided the Dipterans into two classes—the "Menioceres," comprising the Culex or gnats and the Tipulæ; the Brachoceres, comprising the "Musciens," of the family of the "Athericeres," amongst which he places "Tephrites," which he again subdivides into the Dacus and the Tephritis.

The general characteristics of the Dacus of Meigen and Macquart, the Oscinis of Fabricius, the Tephritis of Latreille, are as follows:

Palps enlarged; the antennæ reaching the epistoma, with the third articulation three times as long as the preceding one; the style bare, the abdomen oval.

Dacus oleæ, of which I give description below, is the type of the genus: Length 2 lines (0.005 milimeters); body yellowish gray, tint of head paler, having a black spot on each side of face; eyes grayish blue; front of face tawny; antennæ tawny, with large brown pallets, furnished with a simple hair or bristle; thorax gray, spotted, and a little pubescent, with black longitudinal lines; anterior sides tawny, posterior sides black; escutcheon large and whitey; abdomen oval and blackish, spotted, pubescent, with a yellow longitudinal band which widens towards the anus and forms a transversal band which occupies nearly all the penultimate segment; it is terminated in a point in the females with a pro-

jecting oviduct; its extremity in the male is blunt; wings transparent, always in motion, with yellow veins towards the exterior side, their summit marked by an obscure stain; legs and feet yellow, with the extremity of the posterior ones slightly brown.

Larva apodal, length 5 to 6 millimeters, and resembling a worm; head not very distinct, pointed, retractible, with black mandibles; a third longer than the chrysalis; of a yellowish white; body wings a little projecting.

The chrysalis is in shape like a small barrel of 0.004 milimeter of length and is only the skin of the larva hardened, shortened, and regularized in its shape; it is a perfect oval, yellowish, with the line of the rings of a darker color.

In the year 1826 Professor Risso, of Nice, in the second volume of his Natural History, says, speaking of the *Tephritis oleæ* or Keïron, that he considers this insect as very dangerous to the olive tree. In his opinion the Tephritis comes in swarms towards the end of the summer and deposits two or three eggs in each olive; the larvæ, when hatched, suck all the oily substance out of the fruit.

The olive [says Boyer de Fonscolombe] is very apt, at the time of its maturity, to be attacked by the larva of a dipteran of the muscides family, which is perhaps the bitterest enemy the olive tree has; it lodges itself in the very pulp of the fruit, and one very often finds two, three, and even more larva in one olive; these often forsake the fruit they have attacked before its complete maturity; they then appear in the form of flies, and reproduce themselves the same season by a new deposit of eggs. It is principally at the time of the gathering of the olives that they leave the fruit, especially when it is stored for a time before being ground: they transform themselves into chrysalides in the dust and dirt; the heat changes them in a few days into flies, these linger for some time round those heaps in a state of torpor and await in this state the return of fine weather.

He continues:

This plague seems to me sufficiently bad to encourage in every possible way the prevention of the birth of these insects, and it is important to burn all dust and dirt in storerooms as soon as the olives are taken away; even before. By these means the chrysalides will be destroyed, as well as the flies before the latter have had time to fly away in order to deposit new eggs on the trees.

A few fine days during the winter months suffice to encourage these insects to seek the open air.

Fonscolombe adds:

While looking over the gathered olives some days after the harvest I invariably found larvæ, nymphæ, or insects at the same time in their perfect state. I collected a few nymphæ, and taking them away from the heat placed them in glass vases in a cool place. These nymphæ only became flies late in the spring. This insect does not reduce the quantity of olives; but it spoils the quality, for the olive and the oil it contains are tainted by the flesh of the larva, as the mill crushes all—the olive, the larva, and its excrements; nevertheless, the oil made in 1817 was of excellent quality, though the number of olives attacked that year by this insect was considerable. On the other hand, in 1834 the crop was nearly entirely destroyed, and the small quantity of oil made was nothing but mud These variations can be attributed to the difference in temperature, which may favor or hasten more or less the birth of these flies before harvest time.

I know very well [continues the author] that the precautions above indicated, though they be founded on the habits of these insects, will appear difficult or inadequate in countries where the making of oil lasts all the winter, as in Nice and its surroundings, but then the heaps of olives will have to be carefully watched, especially during midwinter, whenever the temperature, becoming more genial, would tempt the flies to the open air.

The method I would advocate to destroy the worms and flies would be to close up all the openings into the storerooms where the olives are kept, and to put in the room a few robin redbreasts, wagtails, tomtits; these birds willingly seek shelter during the winter months, are tame by nature, and as their food consists principally of insects they would give chase to the *Dacus oleæ*.

This system is practiced in other countries to destroy the weevil in the corn sheds; in my opinion it would answer the same purpose in this case. It will, of course, be necessary to keep water within reach of the birds.

Many different plans have been suggested, but after what has been said previously the best and perhaps the surest way of all is good culture, great care of the trees, and not to sow any crops around them, so as not to weaken them. It has been noticed that insects always select trees that are stunted and have suffered from the effects of frost; it seems as if the strong sap of the healthy specimen did not suit them, and were even detrimental to them.

This advice given by such a careful observer is undoubtedly excellent; many may criticise it, some may find the application if not impossible at least difficult; it is anyhow very sad to think that the question of the *Dacus oleæ*, which was so well treated at the end of the last century by both Bernard and Amouroux, which was again carefully studied in 1840, more than 40 years ago, has not given the results that one would expect in 1890; our olive crops are more than ever threatened by the simple negligence of those most interested in the harvest of the olive trees.

In 1840 Cauvin, doctor in charge of the hospital at Nice, published on the *Dacus oleæ* or Keïron, to which insect he still gives the name of "Tephrite," a very interesting and conscientious work, which he completed in 1842.

The fly, says this author, begins its devastating work at the end of July, seeking out then the olives, to the care of which it will intrust its eggs, leaving unnoticed the *Oliva conditiva* or "Doncinére," the skin of this olive offering too strong a resistance to its auger.

The apode larva with eleven rings, without eyes, and armed with two hooks (mandibles) auxiliaries to the mouth, penetrates into the fruit as far as the stone, burrowing round it to its place of entrance; it remains thus for a fortnight, forms itself into a chrysalis, and then into a perfect insect.

Should the fruit in which the larva has taken its abode fall to the ground or be gathered, it abandons it, for the fruit is no longer sustained by the sap of the tree, and then completes its transformations somewhere else.

In his second book Cauvin gives the result of eleven experiments as follows: In his opinion the fly ceases laying eggs in November, and the insects hatched in March are the result of eggs laid in the autumn, it needs

a frost of 8° Reaumur to kill the larva, and 12° to kill the germs of the eggs; the flies can be kept for 9 and 10 months under glass by feeding them with a sirupy liquid, or still better with grapes or squashed raisins; the larva can only be kept alive with olive pulp; the adult larva taken from one fruit to another will die unless it be on the eve of its transformation; the larva or even its chrysalis will die if put in water or left in the open; the female lays as many as ten eggs in a day and can perform this duty for several days; the best way to ascertain the exact moment for gathering the olives is to fill a small bag of the fruit in April, to visit them a week after and to continue watching them; when it is noticeable that the larva abandons the fruit for its transformation, then is the time to gather the crop. In acting in this way for several consecutive years there will, says the author, be a chance of destroying the insect.

This conclusion may appear a little too affirmative; but Cauvin's two memoirs are drawn up with such great care, and supported by so many proofs that one may place confidence in them and utilize his recommendations at least in part.

Cauvin in the end of his second volume confutes and exposes the opinions of his predecessors.

Sieuve, of Marseilles, and after him Amouroux, of the same city, were wrong in stating that the fly deposited its eggs under the bark of the trees.

It appears impossible that these authors could have been familiar with the larva, for had they examined it minutely they would have been aware that the larva being apodal and very flabby could not possibly leave its cradle to go and attack the olive trees. What may have led them into error is that in the olives which are freed from the larva two holes are found which may have been considered as the inlet and outlet of the insect when they only indicate that the fruit had been inhabited by two insects.

Sieuve has made many mistakes; he does not speak of a miner caterpillar but he mentions a worm with a proboscis which is unshapely, thin, elongated, whitish in color; this worm uses two claws to form a breach in the olive; the ant is very fond of this insect; it tears open the olive, forces the worm out of the fruit, and devours it.

The worm remains 3 months in the bark, the chrysalis for a month remains in a state of torpor, the fly is hatched at about the 15th of December, its food is the gum of the olive tree (on this point alone I agree with Sieuve), the female lays her eggs in the cracks of the bark, the apodal larva hatched in May waits under the leaves the favorable moment to attack the olive tree; we ask in vain where Sieuve could have found these indications. Bernard, the laureate of 1782, finds no other remedy for this plague than to trust to Providence.

Penchienati advised the gathering of the crop in November or December; this precaution seems rather exaggerated, but is anyhow justified up to a certain point.

Risso alone gave the real remedy: Early gathering of the crops, great care and attention to be bestowed on sheds where the gathered fruit is kept, with burning of all sweepings.

In 1843 Mr. Bernard, the engineer, gives very exact information concerning the natural history of the Dacus, of which he does not know the scientific name, but describes the insect perfectly. He says: This fly which appears in August becomes plentiful by the end of September and in October. He admits that there are several generations.

At the same period as Bernard, Louis Roulandi, of Nice, describes the Keïron or *Musca oleæ;* in his opinion this insect has three or four generations annually from August to December; he gives the chrysalis a fortnight to develop itself into a fly; under 10° Reaumur of temperature the insect remains in a state of torpor awaiting the spring to revive; the Keïron attacks at first the early trees which generally have but little fruit; the Pignole of Villefranche, Monaco, La Turlie are spared by it. During the coupling, which lasts an hour, the female seeks the fertilization of her eggs in the body of the male by means of her borer; the great time for multiplication is September. A few olives left on the tree late in the spring will bring on an invasion. If at the end of March there is not a single olive on the trees, there will not be any appearance of Keïron.

It has been shown that certain naturalists, who studied the Dacus at the end of the last century, were mistaken in the most important question of all, the laying of the eggs.

In a very interesting book published in 1845 on the insects which attack the olive tree, Guérin-Menneville discusses the opinion given in 1834 by Laure, and since adopted by other authors, that is, that the Dacus attacks the olive in the autumn, and that it has a first hatching on other plants; this false idea arose from this fact, that Laure had sent to Boyer de Fonscolombe a fly which had originated from a larva found on some cereal, without mentioning where he had gathered it. Boyer de Fonscolombe knowing that his colleague was occupying himself with the study of insects detrimental to the olive tree returned the fly stating, that, in his opinion, it was one belonging to the olive tree. It is easily understood that simple agriculturists as Laure and Bland were received this as gospel truth, and turned into a certainty this simple supposition of one of the masters of science who had been called upon to give his opinion at a distance without having before him the necessary data.

This error could also be explained by the fact that the Dacus had previously been a Tephritis, and that Fabricius had made it an Oscinis; now the *Oscinis lineata* of Fabricius lives in the state of larva to the great detriment of rye; and Linneus places the fly (Frit) amongst the Oscines and taxes it with having destroyed in Sweden the tenth part of the barley crop.

Guérin-Menneville advises the early gathering of olives, and to crush

them as soon as gathered in the years that the fruit has been infested by the Dacus. In operating in this way you still can obtain half the usual yield of oil, while if you waited for the usual time of harvesting the larva has time to eat up the flesh of the olive, and with it the oil which would have been saved had the fruit been gathered earlier.

Lastly, in 1878, Dr. Maurice Girard, in his catalogue of animals useful and harmful, shares Guérin-Menneville's opinion with respect to early gathering; he believes in three generations of flies per annum, and says that the fruit attacked ripens sooner than that untouched.

I have thus given a faithful analysis of the different works that have been published during the last century on the different enemies of the olive; I have shown that the insects which destroy our olive crops have been carefully studied, and that for many years past perfectly sound advice has been given, advice which unfortunately has not been followed by the agriculturists. I take the liberty of giving now my opinion.

I give it only after having gathered the most numerous and precise information from the olive farmers in different districts, even departments, after having made, myself, conscientious experiments and having bred and studied larvæ. It is my opinion that by taking as a basis what takes place in other insects, taking for example the hornet (*vespa cabro*), the first invasion of the Dacus may be composed of flies of both sexes, and specially by females impregnated at the end of the season, which have sheltered themselves during the winter under the bark or in cracks of trees; this fact makes me sincerely regret that the farmers have abandoned the wholesome habit that the Greeks had of scraping with care the bark of their olive trees before the winter had set in. Operating in this way they destroyed any possible refuge for the enemies of their trees.

My opinion is confirmed by the fact that Mr. R. of Grasse, having cut down an olive tree in the middle of the winter, found in its trunk, perforated in many places by time and rain, Dacus developed into perfect insects and in large quantity.

I can not admit that there be only one generation, when all leads to show that there are at least three. I refuse to admit that the egg of the fly is deposited under the bark of trees, and that the larva, soft and apodal as it is, can possibly crawl as far as the fruit and work its way into it; this hypothesis is all the more inadmissible, as everybody knows that the olive hangs at the end of a long peduncle. I think that the Dacus becomes really dangerous only at the beginning of August; it is therefore then that it ought to be hunted and attacked in an intelligent and general manner. The more people will take advantage of the numerous counsels given, the greater will the following crop be the ensuing year. It is evident that Bernard of Marseilles was right when he said that all may be expected from time and study, but this is not sufficient; nature must be helped repeatedly.

The olive tree starts budding in May; from the 20th to the 30th of June the bloom appears. If it takes 2 months for the fruit to form itself and its oil, and to be of sufficient size to allow the larva to develop itself, it would only be in July that the female Dacus would prick the new fruit with its borer and deposit its eggs in the wound.

But what is to be done to fight against the Dacus during the months of August, September, October, and even November? Try and destroy the insect while on the tree is only a secondary means; to gather the olives at an early period would not be a much better mode, for you would only obtain little oil and its quality would be inferior. But a useful thing to do anyhow, would be to use Bernard's liquids, or any others as long as they are sugary, sticky, and aromatic; strings dipped in honey and stretched between the branches are good things, but great care must be taken to gather all the fallen olives, as these may contain larvæ, and their leaving the fruit and grinding themselves for their transformation must be prevented.

In years of great invasion of Dacus, as soon as it is seen that the olives change their tint, that the oily matter has sufficiently swollen the fruit, then all the berries must be gathered without exception, especially if the winter is slow in making its appearance; for it has been noticed that very warm autumns are detrimental to the crops; therefore, if at the end of November the cold does not appear, then gather in all haste and take your stock to the mill.

On the other hand if there are early signs of cold weather, then wait. The cold, even a slight frost, does not destroy the larva, not even the chrysalis, for experiments have proven that they can bear a lower temperature than that which we generally get in this climate, but it stays the development of the plague and consequently diminishes the intensity of the damage.

When the warm weather sets in, if you have not gathered in November do so in March. It is of the greatest importance that not a single olive should remain on the tree by the end of March, nor one on the ground, for the latter would be sufficient to guaranty the destruction of the crop for the ensuing season.

People generally have the bad habit of storing the olives in rooms or attics, in order, it is said, to improve both the quality and quantity of the oil; it is my opinion that this is done simply for economy's sake; either to have all the olives pressed together in one lot, or to have to pay a less amount of manual labor in carrying the crop to the mill. Up to a certain point I admit the system, for it is not every farmer who possesses a mill, and by going to a miller one has to wait one's turn; but in any case keep your stock for as short a time as you can, and watch it with great care; turn over the fruit very frequently, keep the heaps low so as to prevent fermentation and mouldiness, in order also to assist the larvæ to quit the olives; sweep constantly, twice a day is not too frequently, the storeroom, and on no account throw the

sweepings, in which there are larvæ and chrysalides, to the fowls, as it is generally done, for they let a certain quantity get away, neither throw them in the manure heap for the mild heat of the latter will facilitate their development.

Burn all your sweepings or throw them in a pond, for it is proven that the immersion of a few hours will destroy both larvae and chrysalises; also burn some juniper branches in the storeroom where the olives are kept. You can also, if you like, follow B. de Fonscolombe's advice, though it is 40 years old. Keep closed your storerooms, and place in them insect-eating birds, having the precaution to give them water to drink.

A fact which can not be contradicted is that the larva of the Keïron leaves the fruit as soon as it ceases being fed by the tree; the want of moisture or drying of the fruit are also reasons why the larva forsakes the plucked fruit.

The whole mystery is solved in these three things: Early gathering, cares to be bestowed on the fallen fruit, as well as on that gathered.

Count Blancardi, of Sospel, who is always trying to find improvements, said to his farmer neighbors:

> You perceive that your crop is attacked by the Keïron; your olives fall to the ground, and as you know them to be tampered you leave them there. Do you not fear that in so doing you encourage the plague? On the contrary, gather all the fallen fruit in order to force the larvæ to leave it, and then have it pressed; you will get a secondary produce, it is true, but you will have saved your next crop, and your work will not have been useless.

This advice is good to this extent, that it is always dangerous to leave olives attacked by the larvæ of the Keïron upon the ground, because, coming out of the fruit, they find shelter in the inequalities of the soil to accomplish their transformation; but to crush olives containing the remains and excrements of the Keïron is to obtain an oil neither clear nor having good odor, and which ought not to be mixed with oil obtained under good conditions. This is also the opinion of Dr. Maurice Girard, who says:

> The oil made with olives containing the excrements of any larva is detestable.

Rosier, in 1804, and Roubaudi, in 1843, agree in saying that all oil made with fallen and sick fruit has a disagreeable taste.

I have said that the fly, during the winter months, shelters itself in the cracks of trees. I have had proofs of this from the Grasse districts; but on the Riviera, where the winter is so short, if the Dacus rests during the cold season it rouses itself pretty early in the year.

During this period of rest on what does it feed? An interesting question which has not as yet been cleared up. It has been seen to suck sweetened water prepared for it, but what its constant diet may be is not known.

Mr. Peragallo gives the place of honor in this class to the insectivorous birds of all kinds, recommending that they be invited to stay by all possible means. Spiders, too, he has found helpful about the trees, and the genus of Coccinella, to which our lady-bird, with its bright spotted wing covers, belongs. This latter family and their larvæ devour large quantities of the insectivorous enemies of the olive. Of Hymenoptera he describes four which are parasites of the Dacus, and two of the Cionus fraxini; also a Dipteran, *Phorocera picipes* (Roudani), parasite of a Lepidopter, the *Margarodes unionalis*.

(1) *The Eupelmus urozonus*, (Dalman).—One of Hymenoptera, said to follow the Dacus to the olive, lays its eggs in the fruit so that its larvæ may feed upon the larvæ of the Dacus. It is described as from 2 to 4 millimeters in length, green, head triangular, abdomen depressed.

(2) *Eulophus pectinicornis* (Latreille).—Another of the Hymenoptera which, more surely than the first described, preys upon the Dacus, as Mr. Peragallo observed them in his glass cases. The female is a bronzed green; the legs are white, excepting the feet and middle of the hips, which are the same color as the body. The male smaller, plumper, has some white on its abdomen and less green on its legs. It differs principally, however, in that its antennæ have long fan-shaped appendices which themselves are articulated. This insect always selected an olive attacked by the Dacus and laid its eggs in the hole made by that insect; the larva when hatched fastens itself to the larva of the Dacus and soon kills it; in this condition it was pointed at both extremities and of a transparent white color, showing a black cove, its chrysalis slightly flat, shining black in color. The chrysalis of another parasite of the same order, an Eurytoma, was of a lusterless black. The perfect insect was dead black shagreened. It differs further from the former by its slow movements, in which it seems hindered by its long and heavy antennæ.

The last parasite of the Dacus described was the *Ephialtes divinator* (Grav.) one of the Ichneumonides.

While studying the Cionus fraxini Mr. Peragallo found a number of Hymenoptera of the family of Chalcidites and genus Pteromaliens. These were of two distinct species, of which he was unable to find farther distinguishing names.

The first male, blackish metallic green, lighter, however than the female; abdomen rounded and as long as the wings; coupling with

the female it flaps its wings and seems to be in a frenzy. The female, a dark metallic green, knees and legs white, feet black, abdomen terminating in a pointed heart-shape beyond the end of the wings.

The second male short, head large, thorax a light green, wings longer than the abdomen, which is whitish, pointed, heart-shaped, with greenish extremity; legs rose color. It couples frequently and dies sooner than its female.

Female, short, heavily formed, wings longer than abdomen, which is chestnut color, with metallic luster; head aced, thorax dark metallic chestnut, legs rust-color, head as large as abdomen, antennæ yellowish at base, elsewhere brown, enlarged toward the end.

In studying the habits of the *Lepidopterous Margarodes unionalis*, Mr. Peragallo found that it had a parasite among the *Diptera genus Phorocera*: The Picipes of Rondani described as follows:

Length, 4 to 5 millimetres; forehead as wide as the eyes; 3 or 4 hairs fall on the cheeks below the point where the antennæ are inserted; others smaller grow outside of these; ear bristles; very slender antennæ; third articulation four times as long as the second; palpi black; shield black with grey luster; abdomen grayish black; edges of posterior segment hairy; legs brownish, lighter on thighs and tibias.

Female, like the male, third articulation not so long, forehead a little wider than the eyes.

RECAPITULATION.

First. Prune at the end of the winter or beginning of spring at latest; cut off all unhealthy branches and the smallest boughs of the summit of the tree, which are preferred by the insects. Take off at once from the large cut branches the branchlets and burn them the same night; in doing so large quantities of Phlœothrips, caterpillars, false-pucerons and butterflies will be destroyed. Make small piles with the largest branches, leave them as a trap for about 20 days, and then store them after having stripped from them the bark, which is to be singed or soaked in water for a week; large quantities of Phlœotribus or Keïron and Hylesinus, which would have eaten up the young stalks and produced new generations of insects, will be thus destroyed.

Second. Moths, Pyralis, and Moth-worms can also be destroyed by stretching through the trees strings covered with honey, upon which these butterflies during the night will be caught and the Keïron during the day.

Third. Watch over the shoots from March until the winter; shake them lightly from time to time in the early morning over an umbrella turned upside down, into which larvæ of coleoptera and caterpillars will fall; but do not destroy the spiders and the coccinellæ.

Fourth. Use against the Dacus or Keïron Mr. Bertrand's method, which is to hang between the branches when the fly appears, and as

early as the middle of September, flat dishes containing some sweetened and sticky liquid.

Fifth. As far as concern the cochineals, the false-pucerons and the Morphée, cut down the trees or prune them thoroughly, where they are located in very damp places, and as soon as the cochineal appears hunt it out. Kill it and treat the tree as described above.

Sixth. To fight the Phlœothrips keep the trunk and branches as smooth as possible in order to destroy the nests, and leave no perforated wood up the tree, particularly in the higher parts.

Seventh. Give air to the groves, plant the trees wide apart, drain the soil, let weeds be burned slowly in order to dry the atmosphere, and make smoke. Do this generally at night.

Eighth. Do not let the fallen olives lie; pick them up at once and burn or crush them.

Ninth. At harvest time pick up and burn the caterpillars and larvæ of the Dacus and the butterflies fallen upon the sheets.

Tenth. Leave the olive but a short time in the storerooms.

Eleventh. In these storerooms keep the windows closed; turn over the olives twice a day, and sweep up the larvæ and pupæ of the Dacus.

BIBLIOGRAPHY.

BERNARD.—Traité de la Culture de l'olivier (1782–1343).
COUTANCE.—Olivier.—Paris, 1877.
RISSO.—Histoire naturelle des productions de l'Europe Méridionale.—Paris, 1876.
BARBE PÈRE.—Etude sur l'olivier.—Nice, 1875.
BOMPAR.—Mémoire sur les insectes qui vivent aux dépens de l'oliviere.
ROSIER.—Traité d'agriculture (1801).
ROUBANDI.—Nice et ses environs, Paris and Turin (1843).
MARTINENG.—Two reports—sur les insectes rongeurs des oliviers.—Grasse (1863–1864).
ANNALI DE AGRICOLTURA.—Rome (1879).
ANNALES DE LA SOCIÈTÈ AGRICOLE DES PYRÈNÈES-ORIENTALES (1858).
SOCIÈTÈ ENTOMOLOGIQUE DE FRANCE (1886).
Haliday.—The Euton Mag.
TARGIONI TOZZETI.—Annali di Agricoltura.—Florence and Rome (1881).
PASSERINI.—Alcune notizie sapra una specie de insecti.—Florence (1834).
MAZZAROSA.—Le pratiche della campagna Lucchese.—Lucca (1846).
DE FONSCOLOMBE.—Annales de la Société Entomologique de France. (1837 and 1840.)
LICHTENSTEIN.—Manuel d'entomologie à l'usage des agriculteurs du Midi.—(1872.)
GOUREAU.—Annales de la Société Entomologique de France.
SIGNORET.—(1840, 1868, 1869, 1870, 1871, 1878.)
STAINTON.—(London.)
MILLIÈRE.—Iconographie et description de chenilles et de Lepidoptères. 3 vol., with plates. (1859, 1864, and 1869.)
JOUARD DE GRASSE.—(1772.)
CAUVIN.—Observation sur le Tephrite.—Nice (1842.)
GUÉRIN-MENNEVILLE.—Insectes qui attaquent l'olivier. Société Entomologique de France. (1845–1847.)
MAURICE GIRARD.—Catalogue des animaux utiles et nuisibles, 2 volumes.—Paris (1878).
L' ALBÉ LOQUEZ.—Histoire naturelle de la Morphée.—Nice.
A. PERAGALLO.—L' Olivier, etc.—Nice (1882).
F. GOS.—Olivier—Conseils pratiques aux agriculteurs.—Nice (1887).
BRULLÉ.—Rapport sur l'emploi d'une nouvelle machine à dépulper les olives.—Nice (1889). Influence des Engrais sur l'olivier.—Nice (1890). Falsifications de l'huile d'olive et moyens de les reconnaitre.—Nice (1890).

WILLIAM HARRISON BRADLEY,
Consul.

U. S. CONSULATE,
Nice, December 6, 1890.

SPECIAL CONSULAR REPORTS.

BEET-SUGAR INDUSTRY

AND

FLAX CULTIVATION

IN

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1891.

BEET-SUGAR INDUSTRY AND FLAX CULTIVATION

IN

FOREIGN COUNTRIES.

Part I.—THE BEET-SUGAR INDUSTRY.

DISCOVERY OF SUGAR IN BEET, 1747.

REPORT BY CONSUL BULLOCK, OF COLOGNE.

The Beet-root Sugar Industry Association of Germany held its first annual meeting, for 1881, at Cologne, May 23–26. The proceedings consisted of addresses and reports respecting the development and state of the beet-root sugar industry. As much interest has recently been shown on this subject in the United States, it may be opportune to present a brief sketch of its growth and present condition in Germany.

For the discovery of sugar in the beet and the process of its extraction, according to Dr. Scheibler, in a memorial address to the Beet-root Sugar Industry Association, we are indebted to two German scientists, Dr. Andreas Sigismund Marggraf, professor of chemistry and member of the Berlin Academy of Science, who was born at Berlin, March 3, 1709, and to his pupil and successor, Franz Carl Achard, born at Berlin, April 28, 1753.

In the year 1747 there appeared in the reports of the Berlin Academy a communication by Professor Marggraf, wherein was fully detailed the process by which he had been enabled to "find beet-root sugar in abundance, exactly like that extracted from the sugar cane." In this communication Professor Marggraf spoke of the feasibility of profitably manufacturing sugar out of the beet root, and in this respect said:

> From the experiments here set forth it is evident that this sweet salt (the chemists of that time designated every soluble matter "salt") can be prepared in our region just as well as where the sugar cane grows.

It does not appear, however, that Marggraf followed up his discovery by practically demonstrating its capability of being profitably developed. This was left for his pupil, Achard, who, on the 11th day of January, 1799, addressed in a petition to King Frederick William III, a

"Treatise upon the preparation of sugar from the beet root, much cultivated as cattle food in many of the provinces of your Majesty's domains," and prayed, in order that the petitioner might "be enabled to enjoy the fruits of his labor, prosecuted for fifteen years with great diligence and cost," the concession of "the exclusive privilege for ten years for the manufacture of native sugar and the grant of sufficient land, whose soil would be adaptable to beet-root culture," where said beet-root culture would be carried on after his method, so that he could be placed in a position to prosecute his enterprise, for which he had been assured of the assistance of capitalists.

After searching examinations and manifold negotiations, the King granted a loan of 50,000 thalers ($35,700), with which Achard bought suitable land in Lower Silesia, where, in 1801, he built a factory, which was set in operation in March, 1802. Achard's enterprise found many imitators in that same year. General Blanknagel erected a sugar factory in the government of Toula (Russia), and in this and the following year two sugar factories were erected near Paris and several in Prussia, the most important of which were those of Baron von Koppy, near Strehlen, in Lower Silesia, and of Von Nathusius, in Althaldensleben. But shortly after this the wars of Napoleon swept over Prussia, and for many years the development of the sugar industry made but little progress.

In the winter of 1809–'10 the factory of Achard fell a prey to the flames, and its founder was left heavily involved in debt. Nothing daunted by these misfortunes, Achard courageously set about to devise ways and means to extricate himself from debt and start his enterprise anew. He succeeded in obtaining a release from the King of the debt of 50,000 thalers, and a new advance of 20,000 thalers, wherewith he paid his most pressing debts, and erected upon the ruins of his factory a school for practical instruction in the beet-root sugar industry. His efforts, however, did not meet with the success he had hoped. The industry made no progress, and Achard, at the time of his death, April 20, 1821, had not experienced the satisfaction of seeing the prosperity of that industry to which he had devoted the best years of his life, and for which he had sacrificed fortune and an honorable position. It is true that about this time the continental blockade had driven the price of sugar up to 6 to 7 francs per pound, avoirdupois, and after Napoleon offered a million of francs premium for beet-root sugar many sugar factories had been erected in France; but as they had been created by the Empire they disappeared shortly after the French restoration. One, only, among all the sugar manufacturers of France, was able to bear up against the flood of disaster which swept over them, and this exception was notable, inasmuch as it marked the turning point from whence the native sugar manufacture rose through many difficulties to be self-sustaining.

Crespel Delisse established a factory at Lille on the plans indicated

by Achard, and subsequently another at Arras. By remarkable energy and capability he raised the industry from prostration to prosperity, and in 1828 he was owner of three factories and part owner of three others. The number of beet-sugar factories in France at that time reached 103. During the following 20 years Crespel Delisse remained the great authority in all matters pertaining to the industry, and was ever the honest adviser and instructor of those who sought information from the store of his experience.

From that time forth the industry grew apace. In France, in 1837, beet-root sugar was first subjected to taxation, and there were 585 factories in that country, which produced 1,000,000 centners of sugar.* Germany had at that time 156 factories, which produced out of 2,764,000 centners of beets 153,300 centners of sugar, or 1 centner of sugar to 18 centners of beets. In 1841 the system of taxing the beet-root was introduced into Germany by imposing a tax of 3 pfennigs per centner. This tax has been gradually increased until it now amounts to 80 pfennigs† per centner. This method of levying a tax upon the beet-root instead of upon the sugar produced has worked satisfactorily, and is cited approvingly in contrast to the changeable systems of other countries.

The following table shows the growth of the sugar industry in Germany for the last five decades:

Season.	No. of factories.	Beet root worked.	Raw sugar produced.	Tax on beets per centner.	Taxes received, less amount repaid for drawback.
		Centners.	*Centners.*		
1840–'41	145	4, 829, 734	248, 102	3	15, 841, 119
1850–'51	184	14, 724, 309	1, 066, 979	30	15, 628, 293
1860–'61	247	29, 354, 032	2, 530, 520	75	25, 799, 490
1870–'71	304	01, 012, 912	5, 259, 734	80	39, 501, 081
1880–'81	331	126, 415, 938	10, 600, 000	80	50, 000, 000

The foregoing table shows that since 1850 the sugar industry of Germany has doubled with every decade. A wonderful progress, truly, whose effect upon the economical condition of the country can hardly be estimated. A drawback of taxes is allowed upon sugar exported, and is calculated upon the basis that 11.75 centners of beets yield 1 centner of sugar. This estimate has been proved to be practically correct, the average for the last nine years being 11.60 centners of beets to 1 centner of sugar. The consumption of sugar in Germany falls greatly below that in the United States or England, having averaged for the last three years 14.50 pounds, avoirdupois, per head, or about one-third of the annual average consumption per head in the United States. This

* One centner is equal to 110.5 pounds advoirdupois.
† 80 pfennigs are equal to 19 cents.

comparatively small consumption is a cause of complaint by the sugar manufacturers and is generally attributed to the rate of taxation imposed on the industry. If we take 30 marks as the average price of 96 per cent. raw sugar, including taxes (and the price has not recently varied from this), the tax of 80 pfennigs on the beet-root increases the price of sugar nearly 50 per cent. A reduction of 45½ per cent. upon the rate of taxation upon sugar was made by the French Government, October 1, 1880, and in the following 6 months the consumption of sugar had increased at the rate of 35 per cent. per annum, while the French minister of finance had estimated an increase of 20 per cent.

This rate of increase will show for France, in 1881, a consumption of 27¾ pound avoirdupois per head. It is therefore much discussed whether it would not be advantageous for Germany to follow the example set by France. This course would no doubt widen the field of agricultural activity. The industry is becoming more purely agricultural from year to year; that is, it is no longer the large landed proprietors and capitalists who alone erect and operate sugar factories, but the small landowners, and even the peasants, unite and build factories for the manufacture of sugar from the beets raised in the neighborhood.

Beet-root culture, as practiced in Germany, does not in the least affect the yield of other products, for the thorough cultivation which it requires increases the fertility of the soil and does not exhaust its mineral constituents; the sugar is drawn from the atmosphere, and the richer the beet is in sugar the less mineral substance it contains. It gives remunerative employment to the laborer in winter, and in summer is an inexhaustible source of great and increasing wealth to the nation.

GEO. E. BULLOCK,
Consul.

UNITED STATES CONSULATE,
Cologne, June 1, 1881.

GROWTH OF THE BEET-SUGAR INDUSTRY IN EUROPE (1879).

REPORT OF CONSUL POTTER, OF STUTTGART.

As experiments in the manufacture of beet-root sugar are being made upon a somewhat extended scale in some parts of the United States, I have presumed that a few statistics concerning its production in Europe, coupled with facts and opinions gathered from statements of the most intelligent and successful German manufacturers, might be of possible interest at this time.

Highly intelligent experts in the beet-root sugar industry of Germany, who have carefully studied the climate and soil of America, do not hesitate to express the opinion that in a few decades the United States will supply their own enormous sugar demand chiefly from the beet, as has been the case in Germany for many years past. The progress of this

industry in the United States is being watched with the greatest interest by manufacturers in Germany, who, judging by the light and hasty manner in which this difficult subject is treated in some of the plans for new beet-sugar manufactories in the United States, predict that severe disappointment will be the result.

The following facts are therefore cited, not only as a timely warning, but also for the purpose of encouraging those who propose, in a judicious way, to embark in a noble enterprise that may lead to results of the highest importance to the agricultural interests of the country.

In the first place, which parts of the American Union appear to be most favorable to the production of the sugar-beet?

The map of Europe and the long experience of manufacturers and producers there furnish a ready answer: The northern part of France, Belgium, a part of Holland, the Lower Rhine district, Hanover, Brunswick, the neighborhood of Magdeburg and Halle, Silesia, Bohemia, and a portion of fertile Poland furnish by far the greatest part of the sugar product of Europe. In all of these countries, which are those best adapted to the culture of the beet, the richest lands are devoted to this purpose. Their climate is generally humid and too cold for grapes and Indian corn, not because the summer is too short for the latter, but because the average temperature from the end of March to the end of October is too low and the humidity of the atmosphere at the same time too great. The countries named have during the year from 20 to 30, seldom more than 40, so-called summer days; that is, days when the thermometer rises to 77° Fahr.

The abundant dews, which are produced by cool nights, are a life element with a northern plant like the beet. South of 50° latitude in France and Germany there are but few sugar manufactories, and these are, by reason of the climate, more unfavorably located than those in the north. In Southern France proper, in Switzerland, Italy, and other countries of Southern Europe, there are no sugar manufactories, with the exception, perhaps, of a few that may have been established as an experiment, but which do not promise successful results. The reason of this probably is that in the northerly countries the growth of the beet goes on uninterruptedly during the summer in consequence of the greater moisture of the climate, while in autumn the cool nights check the further growth and develop the sugar in the roots.

In the warm countries of Central Europe, however, where Indian corn flourishes, the dry warmth of summer frequently impedes the growth of the sugar-beet, while the warm autumn encourages the growth *only* of the plant, instead of the formation of sugar. The development of sugar in the maple tree is similar to that in the beet, in this respect, that both require for this process warm sunny days and cold nights.

If, besides the northerly countries already named, there were no other parts of Europe adapted to the growth of the beet, viz, those parts having a hot summer, like that which generally prevails in the United

States, the prospects of the latter as a sugar-beet producing country would be very unfavorable. Fortunately, however, the experience in eastern part of Europe, particularly the extended neighborhood of Kiew, in Russia, which is the chief center of the Russian beet-sugar industry, shows that the beet may be cultivated with great success in countries where the summer is hot, provided the climate is not too dry.

From the foregoing facts it is evident that the establishment of beet-sugar manufactories in the United States should not be undertaken until the subject in all its bearings has been carefully and thoroughly investigated, for it is, of course, an essential point in the successful management of every manufactory to have, not only in most years, but *every year*, a plentiful and certain supply of raw material of best quality at command.

Besides the climate, therefore, the matter of fertilization becomes a most important consideration. The beet plant draws its sugar mainly from the fertilizers used, and not from the body of the native soil. For this reason there need be no fear of exhausting the soil so long as it is highly manured. There is not in the vegetable kingdom, probably, another plant that will so quickly impoverish the soil when fertilization is insufficient or wholly wanting. It is, therefore, evident that success in the cultivation of the sugar-beet is dependent upon bountiful and unstinted fertilization. Even with this provision, every other year there should be planted different intervening crops upon the same soil. There are sugar plantations in Europe whose originally excellent soil has become totally exhausted, simply because of insufficient fertilization, and, as a result, the manufactories connected with them have failed.

A brief reference to the manufacture of sugar, from its beginning in Germany, may be of service to those proposing to engage in a similar enterprise in America.

As is well known, the sugar of the beet was discovered by a German chemist named Sigismund Marggraf. On the 3d of March, 1747, at a session of the Academy of Sciences, in Berlin, he stated that he had found, in several of the indigenous plants, the same kind of sugar as that in the cane, and that the Silesian beet contained the greatest proportion of saccharine matter. He also proved that the extraction of sugar from this plant by his method was not only possible but might also be made profitable.

Political disturbances prevented Marggraf from enjoying the honor of establishing the first beet-root sugar manufactory, but his pupil, Achard, founded the first establishment of this kind in Cunern, in Silesia, in the year 1790, and obtained 6 per cent. raw sugar and 3 per cent. molasses from the weight of the freshly harvested beets. Achard wrote to a friend in France concerning his success, and the subject was agitated there. His letter, in which he dwelt upon the advantages of the beet-sugar manufacture and its great benefits to agriculture, was published in all the newspapers of France, and created

throughout the country quite a sensation. As a consequence, in the year 1800, two establishments for the manufacture of beet sugar were founded, by way of experiment, in St. Owen and Chelles, near Paris. The results, however, were so unfavorable and discouraging in comparison with those of the Silesian manufactory that this branch of industry was abandoned, and rarely referred to in France for many years afterward, except in terms of ridicule.

Some time later, Napoleon I, in order to facilitate the accomplishment of the continental blockade, which was planned as a blow at England, encouraged the manufacture of beet sugar by enormous appropriations of money. But with his fall most of the manufactories failed, with heavy losses.

About the year 1812–'15, animal charcoal began to be employed for the purpose of bleaching and purifying the sugar, thus opening a new era for this industry. This most important invention, in connection with further progress in chemistry and mechanics, was the means of calling into existence no less than 103 manufactories in France in the brief period of the 13 years previous to 1828. The total product of these 103 establishments was only 6,630,000 pounds of raw sugar, being an average for each manufactory of about 66,000 pounds, or the product of about 40 English acres of beets.

The German manufactories began even more cautiously, for in the year 1836, 122 establishments produced only 3,111,901 pounds of raw sugar, made from 56,761,530 pounds, or 28,007 tons of beets, making an average for each manufactory of only 25,525 pounds of raw sugar and 459,250 pounds of beets, which would be about the yield of 20 English acres fairly cultivated, and producing an average of about 11 tons to the acre.

This commendable prudence and caution in the establishment and manipulation of manufactories in France and Germany was a consesequence of former enormous losses, resulting from the attempts of enterprising men to engage extensively in a business which they did not understand, and before they had studied it with sufficient care to master the difficulties that stood in the way of success. Their experience should be a serious warning to producers in America, and admonish them to begin with small, very small establishments, and study every step taken until they have learned the business in its minutest details, and are sure of a profit on their labor and investments. Expansion and large investments in this industry will then be safe, for the demands of the market for their production will be substantially without limit. The planting of 100 acres would be a liberal beginning for the first year. With even this small beginning the planter might pay dearly for his agricultural experience before he had carried a single load of his produce to the "new factory."

The experience of properly keeping the beets after harvesting is often as dear as that gained by labor in their culture. As soon as the

beets are taken from the ground, very shallow trenches are dug, and the beets are piled therein in such manner as to have at least three-quarters of the heap above the surface of the earth before covering.

The danger of heating in the heaps covered with earth is fully as great as that of freezing. This heating is caused by making the heaps too high, and the injury resulting therefrom, as in the case of fresh grain, can never be made good. For this reason, the cellar is a most objectionable place in which to store the beets. The first essential to safety is the ripeness of the beets, and a moderate temperature at the time of harvesting. The golden rule "out of the earth into the earth" is always to be kept in mind, for in the air, particularly when the sun shines, the roots soon wither and become soft and elastic, in some degree like rubber.

This is the first step towards decomposition after they have been taken out of the ground, and is more to be feared than frost. If possible, the beets should be buried or covered the same day that they are harvested, and should be placed in heaps not more than 2½ feet high by 3 feet broad, and should be covered just deep enough to prevent freezing. Straw is always dangerous on account of heating, decay, and mice.

That the caution of the German manufacturers was well advised is proved by the fact that the number of factories, which had risen in the year 1838 to 159, had decreased in the year 1845 to 96. From this depressed condition, with the assistance of past experience and new inventions, the industry progressed in a healthy manner, and the following statistics show how steadily the average production of the different manufactories has increased up to the present time:

Year.	No. of manufactories in operation.	Total amount of raw sugar produced.	Average product of raw sugar in each manufactory.	Beets required for 100 pounds of raw sugar.	Remarks.
		Pounds.	*Pounds.*	*Pounds.*	
1836	122	3,111,901	25,525	1,989.00	About 20 pounds beets to 1 pound sugar.
1845	96	33,489,014	348,848	1,624.35	About 16 pounds beets to 1 pound sugar.
1850	184	117,901,179	640,789	1,514.90	About 15 pounds beets to 1 pound sugar.
1855	216	193,063,832	893,834	1,381.25	About 14 pounds beets to 1 pound sugar.
1860	247	279,622,460	1,132,072	1,281.80	About 12¾ pounds beets to 1 pound sugar.
1865	295	410,387,276	1,391,089	1,292.85	
1870	304	581,200,607	1,911,871	1,281.80	
1875	310	765,092,497	2,468,017	.....	
1877	326	848,259,659	2,568,017	.....	
1878–'79 ...	329	850,850,000	2,585,700	.....	

NOTE.—In the years 1860 and 1870 the quality of the beats raised was unusually good.

The weights above given are stated in English pounds.

The progress made in the process of extracting sugar from beets is shown by the gradually decreasing amount of beets required to produce a certain weight of sugar. In the year 1836 about 20 pounds of beets, and in 1860 only about 12 pounds were needed to make 1 pound of raw sugar.

The production of beet-sugar in all Europe during the 4 years ending June 30, 1879, was as follows:

Year.	Weight.	
	Centners.	English pounds.
1875-'76	27, 452, 255	3' 033, 474, 177
1876-'77	22, 022, 823	2' 433, 521, 941
1877-'78	28, 416, 544	3' 140, 028, 112
1878-'79	28, 200, 000	3' 116, 100, 000

The total production for the year 1878-'79 was divided among the several European countries as follows:

Countries.	Weight.	
	Centners.	English pounds,
Germany	7, 700, 000	850, 850, 000
France	7, 600, 000	839, 800, 000
Austria-Hungary	6, 700, 000	740, 350, 000
Russia and Poland	4, 300, 000	475, 150, 000
Belgium	1, 300, 000	143, 650, 000
Holland and other countries	600, 000	66, 300, 000
Total	28, 200, 000	3, 116, 100, 000

Showing a consumption of about 10 pounds per year, or less than half an ounce per day to each inhabitant of Europe.

Upon this historical basis perhaps a better view may be taken of the general considerations connected with the establishment of beet sugar manufactories in the United States. Taking as a basis of judgment the facts developed by the beet-sugar production of Europe, the climate of the New England States, the vicinity of the Great Lakes, and in the same direction or zone westward, would appear to be the localities most favorable for the production and culture of the sugar-beet. But, in view of the important fact that the so-called Indian summer of the Middle States is very favorable to the best development of sugar in the beet, the boundary of successful cultivation may be possibly extended to the Ohio River. It may, however, be considered hazardous to undertake this industry south of this line, unless tests and experience shall prove the contrary.

Besides the Indian summer, the United States has another important advantage in the fact that the spring season, although somewhat late, continues warm from its beginning, and is therefore for the young beet more favorable than the cool, moist weather which sometimes occurs in Germany in the months of April and May.

In considering the cost of cultivating and harvesting the sugar-beet the farmer of the United States may safely consider himself as possessing a high per cent of advantage over the European farmer in the vastly superior machinery for harvesting and cultivating which is always at his command. He will also be free from the enormous ad valorem tax*

* The imperial tax collected by the German Government upon sugar-beets raised within its jurisdiction amounts to more than 80,000,000 marks per annum.

which the German farmer is obliged to pay upon his beets before they are crushed at the sugar factory. In the process of manufacture in late years many improvements have been introduced. The present diffusion method (extracting the sugar with water) does not require more than half as many workmen as by the former method of hydrostatic pressure.

It may also be considered a fortunate circumstance for the United States of America that the manufacture of beet-sugar has not heretofore been attempted on an extensive scale. The European farmers and manufacturers have suffered all the discouragements and losses incident to 20 years of experiments in developing this industry before it began "to pay." This development has been slow because the disasters resulting from such experiments had made those engaged in the enterprise very cautious until perfection in methods of manufacture had been nearly attained. The advantages of all this expensive and tedious experience is now available to the people of the United States, and there seems to be no reason why the inauguration of this great industry into many of the different States of the Union should not be met on all sides with substantial and hearty encouragement. With a more favorable climate and a boundless area of better soil, with superior machinery and cheaper fuel, with labor in abundance and an unlimited market there appears to be no obstacle in the way to prevent the manufacture of beet-root sugar from being prosecuted with a degree of success in the United States far in advance of that attained by European producers and manufacturers.

The enormous advantages of sugar-beet planting to the agriculture of a country having a domain so extensive as that of the United States can not be estimated too highly. These will become evident when a farmer, having the advantage of a favorable climate and suitable soil, begins operations with a small plantation and gradually increases his business, according to his success, until he arrives at independence, which he surely will do, with prudent and skillful management and proper surroundings.

No industry could probably be introduced into the United States that would more rapidly add to the wealth of the country and the contentment of its people, for its prosecution requires a large number of workmen, and its product comes wholly from the soil. For these reasons, and with a favorable commencement, it is not extravagant to predict that its growth would be so rapid that in a few decades the sugar production of the United States, as an article for home consumption and export, would rank second only in importance to the great staple productions for bread.

In conclusion, it is proper to refer to the subject of suitable sugar-beet seed for America. Germany and France produce two varieties of sugar-beets. The first produces a comparatively small weight to the acre. But these are not only much richer in sugar than the other kind, but grow entirely underneath the soil, a fact of much importance to the

farmers of America where there are often severe frosts in the month of October. In France the frost rarely appears in November, and consequently the French beets, which frequently grow half above ground, are not greatly endangered. The German sugar-beet seed is, therefore, greatly to be preferred for the climate of the United States. It is predicted that the difference in the product of these two varieties of seeds will be so great in the United States as to produce in the manufacture of sugar success with one variety and, by reason of frost, etc., perhaps, entire failure with the other.

The seed of the Silesian beet and the seed grown in the vicinity of Magdeburg are most to be recommended.

J. S. POTTER.

UNITED STATES CONSULATE,
Stuttgart, November 1, 1879.

BEET-ROOT SUGAR MACHINERY AND MANUFACTORIES (1880).

REPORT BY CONSUL POTTER, OF STUTTGART.

With a view of furnishing to those interested information as full as possible concerning the manufacture of beet-root sugar in Germany, I herewith forward carefully prepared estimates for the construction of machinery for a mill, complete in all particulars, for the manufacture of sugar from beet roots.

These estimates are furnished by an establishment well know in Europe as being among the most responsible and advanced in the manufacture of the best quality of improved machinery for the purpose named, and they provide for a mill capable of working up 100 tons of beets daily and also for a mill with a working capacity of 500 tons daily.

The manufacture of beet sugar by hydrostatic pressure is now obsolete in Germany, the diffusion process being adopted instead, because the percentage of sugar obtained from the beets has been largely increased by the latter method. By the old process 20 to 30 pounds of beets were required to produce 1 pound of sugar. By the new method 10 to 12 pounds only of beets, of good average quality, produce 1 pound of sugar, besides a considerable percentage of molasses. The estimates herewith submitted are for the most improved machinery for the modern diffusion process.

A plan of a building for a medium-sized mill is also herewith submitted. It should be remembered that the measurements and figures thereon represent *millimetres*.

I have attached to the estimates furnished copies of the letters received from the Braunschweig Company, in order that those interested in the subject may be made familiar with the responsible character of the statements therein contained.

A table showing all the elements of cost that enter into the production of sugar by the improved German methods is also given. This table is made up from the carefully tested average results of three years' operations of a well-organized and successful manufactory in the northern part of Germany, and may be confidently relied on as accurate. The German Government collects a revenue tax on the value of the beet roots after they are washed and ready for cutting. The official collecting this tax has a room in every manufactory and superintends the weighing of the beets. As the American manufacturer will not have to bear a similar burden this important item of cost has been omitted in the table referred to.

For the benefit of the farmer proposing to engage in the culture of the sugar beet, I will suggest that deep, rich, moist, bottom land is dangerous ground upon which to experiment with a view of obtaining successful results. From such land he may obtain enormous crops in bulk and weight (20 to 25 or more tons per acre), but his product will be merely water with very little sugar, and the more tons he raises the more complete will be his failure. He will furnish the manufactory with a large amount of bulky material while the product in sugar will be very discouraging. It is well known that many of the French farmers, who cultivate a kind of beets which grow very large and partly above ground, often produce 30 tons to the acre, and yet utterly fail in the business, while the prudent and thinking German succeeds admirably with smaller beets, producing 11 or 12 tons to the acre. In one case a great weight of water is produced, containing a small amount of saccharine matter, while in the other a beet is produced rich in sugar properties, and yielding more pounds of sugar to the acre with less than half the labor and cost of production.

Rolling, and even hilly land, where there is not an excess of moisture, is best for the sugar beet. It should be strong and well enriched. One of the very best fertilizers is wood ashes, and material containing alkaline properties. The elements that produce sugar in the maple tree will develop sugar in the beet. In this connection it may be mentioned that ashes from the wood of the sugar maple tree are regarded as among the most valuable of all ashes in the production of potash.

These hints will be quite enough for the intelligent farmers of the United States, and if those who propose to engage in the culture of sugar beets will carefully study the subject they wish to master, and remember that they should seek to produce the largest quantity of sugar in the smallest amount of raw material, and that it is concentrated substance and not bulk or magnitude of material that is wanted, success in sugar-beet culture will be assured.

The reduction in the cost of a mill smaller than the one for which estimates in detail are herewith furnished would not, of course, be in proportion to its reduced capacity. I have equally complete estimates for a manufactory capable of working up 500 tons of beets daily.

The recapitulation only of the total cost of such an establishment is given.

In order to insure the success of the experiment in making sugar from beet-roots in the United States, it is safe to recommend the construction of an establishment large enough to control all the economical advantages which science and late discoveries present.

For further information I would refer to the following letter, received from the directors of the Braunschweigische Maschinenbau-Anstalt in Braunschweig:

BRAUNSCHWEIG, *March* 22, 1880.

SIR: From the inclosed note you will see that at the price for beet-roots of 1.034 marks per centner, 0.800 mark duty, the hundredweight of beet-roots will cost, to be worked up, 2.617 marks, including both sums. Consequently, without duty, which we understand is not paid in America, the cost is reduced to 1.817 marks.

The amount of coals used will depend upon the size and construction of the manufactory; 12 to 30 per cent. of coals to the weight of beet-roots is required. If we reckon the cost at 1 mark, you will see from the inclosed note that here in Germany about 15 per cent. coals are used.

With regard to wages, 0.158 mark is, as you will observe, paid per centner of beet-roots, the men earning, on an average, 1.75 to 2 marks, the women 1 to 1.20 marks per day. All other details you will find in the table following.

The calculation of cost for the production of 1 centner raw sugar in America, resulting herefrom, is very simple. The result will differ according as you take 10, 11, 12 or more centners beet-roots to the centner of sugar. With good beet-roots we require here, with the three grades of product, 10 centners of roots to 1 centner of sugar. One centner sugar will, therefore, cost 10 times 1.817 =18.17 marks, without duty. Besides this, there will be a gain of about 3½ per cent. molasses on the weight of beet-roots, which represents a value of about 5 marks per centner, according to present prices.

There still remains the food product for cattle, etc., the value of which we presume the American farmer understands, and we have not, therefore, given it a price.

I am, sir, yours, most respectfully,

BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT.
M. HECHT.

Hon. J. S. POTTER, *United States Consul.*

The following table shows in detail the average cost of extracting, by improved German machinery, the raw sugar produced by 1 cwt. of beet-roots of good average quality:

Table showing average cost of working up 1 *centner beet-roots, the product of which is about* 10 *per cent. raw sugar and* 3½ *per cent. molasses*=11 *pounds sugar and* 3.65 *pounds molasses.*

Elements of cost.	German marks.	United States cents.
1 centner beet-roots, washed and ready for cutting	1.034	24.61
Coal	0.153	3.90
Coke	0.011	
Muriatic acid	0.004	1.09
Bone charcoal	0.019	
Materials	0.023	
Press-cloths	0.006	2.23
Sacks	0.017	
Limestone	0.006	
Repairs	0.065	
Wages	0.158	4.78
Salaries	0.043	
Interest	0.101	6.61
Miscellaneous expenses	0.022	
Commissions	0.015	
Insurance	0.017	
Wear and tear, depreciations, etc	0.123	
	1.817	43.22

It will be seen by the foregoing table that the cost of producing clear raw sugar from beet-roots in Germany is about 4 cents per pound. After the sugar there still remains a considerable percentage of molasses, the value of which should be credited to the cost of producing the sugar, thus reducing the actual cost of good raw sugar from beet-roots to about 3½ cents per pound.

The value of the residuum as food for cattle or manure will be estimated according to the demand for it existing in the neighborhood of the factory.

BRAUNSCHWEIG, *March* 12, 1880.

SIR: Respectfully referring to your note of the 4th instant, we have the honor to submit to you the inclosed two estimates for the complete fitting up of sugar manufactories for the working up of beet-roots, in the one case of 100,000, in the other of 500,000 kilograms daily.

These estimates can not be considered entirely reliable *under all circumstances*, as a knowledge of the building, locality, and water privileges is indispensably necessary for the drawing up of binding contracts. They may, however, be regarded as essentially correct, and only subject to unimportant changes.

We add drawings of the ground plan of a middle-sized manufactory, and are prepared to give further details.

According to your wish, we have the honor to forward you two copies of the ground plan of the sugar manufactory, Jülich, and at the same time beg to state that we will willingly send one or two skillful engine-fitters to America with the machines to assist in their erection, for whom, besides free passage there and back and entirely free accommodations, 10 marks per man per day, including time of journey, would be required.

Yours, most respectfully,

BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT.
M. HECHT.

Hon. J. S. POTTER,
Consul of the United States of America in Stuttgart.

Estimates for sugar manufactory.

No.	Machinery, fixtures, etc.	Kilograms.	Price.	Total.
	A.—*Machinery and apparatus.*		*Marks.*	*Marks.*
1	2 beet-root washing-machines with perforated iron *5¼, strong metal drums, and with iron boxes, each of *3,250¼, length. The drums have a diameter of 1,100¼, are provided with crosses forged in a piece, and one of them has a stone sorter. The machines have each 2 deposit valves, 2 manhole plugs, gaseliers and communicating cylinders, including stationary and loose pulleys ..... per piece..	.....	3,000.00	6,000.00
2	2 beet-root wagons capable of containing 500 kilograms, per piece	.....	350.00	700.00
3	1 cutting machine with a disk, armed with 8 boxes and communicator, with stationary and loose pullies and disengaging gear, and with filling funnel	.....	.....	2,100.00
4	16 blade-boxes for the same ..... per piece..	.....	30.00	480.00
5	10 sets of finger-blades for the same ..... per set..	.....	32.00	320.00
6	10 sets of lateral-cutting blades for the same ..... do....	.....	40.00	400.00
7	2 railroad cutting-wagons of sheet-iron, with filling funnels ..... per piece..	.....	230.00	460.00
8	70 running rails, including the necessary tenter-hooks, per running millimeter	.....	1.20	91.00
9	14 diffusors of 1,100¼ and 1,570¼ height in the direct plates, complete each with 2 manholes, the upper one with horizontal covers capable of being turned, the lower one with strong covers hanging on hinge joints. These are arranged for caoutchouc packings, to be tightened by means of wrought-iron hoops and span-screws. On the jars are brackets for the reception of transferable pipe-supports and props for the junction of the conduit of pipes, per piece, 925 kilograms	12.950	53.00	6,863.00
10	14 metal stop-cocks for the same of 20¼ ..... each..	.....	9.00	126.00
11	14 perforated wrought-iron sieve bottoms to be inserted in the upper manholes of the diffusers, and 14 similar ones for the lower vaulted bottoms of the jars. The jars receive the whole diameter of the diffusors, and lie with the lower inner edge of the manhole in an horizontal position at 50 kilograms ..... each..	700	0.75	525.00
12	14 calorisators, each of 1.5 square meter heating surface, with brass pipes and stuffing-box packing ..... per piece..	.....	250.00	3,500.00
13	14 steam-port valves of 33¾ ..... do....	.....	24.00	336.00
14	14 self-acting steam exhaust port valves of 26¼, with gauge cocks ..... each..	.....	26.00	364.00
15	14 thermometers ..... do....	.....	15.00	210.00
16	14 transferable pipe supports ..... do....	.....	9.00	126.00
17	14 wrought-iron loosening keys ..... do....	.....	6.00	84.00
18	14 guide eyes to the same ..... do....	.....	3.00	42.00
19	2 keys to the manholes of the diffusers ..... do....	.....	6.00	12.00
20	1 metal purging cock ..... do....	.....	.....	20.00
21	57 valves of 78¼, with red brass spindles and stuffing boxes, with wrought-iron hoop, so constructed that the conical valves do not turn ..... each..	.....	50.00	2,850.00
22	7 wrought-iron winch cranks ..... do....	.....	3.00	21.00
23	A complete cast-iron set of pipes, with cut flanges and bored screw holes ..... per kilogram..	2,000	33.00	660.00
24	284-edged caoutchouc packings for the manholes of the diffusers ..... each..	.....	6.00	160.00
25	To about 280 drillings, the requisite caoutchouc sheaves and screws ..... each	.....	2.00	560.00
26	Iron foundation below the diffusers consisting of cast-iron horses and square supports, including hooping..per kilog'm.	2,500	24.00	600.00
27	1 cutting worm between the diffusers, including wrought-iron trough and motor ..... per kilogram..	2,750	63.00	1,732.50
28	Flooring plates with perforated metal between the diffusers ..... per kilogram..	800	0.70	560.00
29	2 improved cutting presses ..... each..	.....	1,325.00	2,650.00
30	1 distributing worm screw to the above presses, including wrought-iron trough, etc., omitted	.....	.....	.....
31	6 deposit boxes for cuttings on the cutting floor ..... each..	.....	60.00	360.00
32	The entire communication of motion for the whole of the working machines (driving engines), with all of the iron parts for the elevators and transports, for the moving of the beet roots and beet-root cuttings, as well as the coal, the brackets, the drop, etc., consisting in well-made rollers, pulleys, wheels, bottom plates, and brackets with metal pillars, etc ..... per kilogram..	35,000	63.00	22,050.00
33	Tin pockets and chains for the protractors ..... do....	200	1.30	260.00
34	90 wooden fillets ..... each..	.....	.50	45.00
35	320 fastening screws ..... do....	.....	.50	160.00
36	Wrought-iron chains with steel screw bolts in drawn wrought-iron pipes ..... per kilogram..	800	1.10	880.00

* The measures are given always in millimetres and the weight in kilograms.

Estimates for sugar manufactory—Continued.

No.	Machinery, fixtures, etc.	Kilograms.	Price.	Total.
	A.—*Machinery and apparatus*—Continued.			
			Marks.	*Marks.*
37	1 grindstone for the blades, with iron trough, including stationary and loose pulleys			150.00
38	4 complete separating pillows of 1,500¼, and 1,700¼ height in the direct plates, with armature to the same, consisting in: 1 passage valve, 1 steam valve, 1 carbonic-acid tube, 1 carbonic-acid worm, 1 steam valve, 1 juice outlet valve, 1 scum worm, 1 juice inlet valve, 1 knee and 1 cross support, 1 passage cock, 2 guide eyes, 2 loosing rods, 1 winch crank, and saturer, with cover and drying tube.....per piece..		850.00	3,400.00
39	4 tubes for saturer as before .....do....		850.00	3,400.00
40	2 chalk measuring barrels, each with two cocks.....each..		100.00	200.00
41	6 scum-filter presses, each with 18 chambers; each chamber with fluted lateral planes, unscrewed sieve plates, a metal drilling apparatus for the cloths, and an outlet cock, the valves with turned wrought-iron columns, wrought-iron cones .....each..		1,200.00	7,200.00
42	1 stone catcher, with sieve.....			100.00
43	6 sugar centrifugal machines, with welded drums and full bottom plates, with protecting hoop.....each..		1,000.00	6,000.00
44	1 complete double mash machine			1,350.00
45	1 sugar carriage with juice catcher.....			120.00
46	2 iron washing basins, with pipe connected below them, and 2 outlet cocks.....			875.00
47	1 complete coal-washing machine, with wheel communicator entirely of iron			2,200.00
48	1 tilting apparatus for the same			150.00
49	All the iron parts to 3 Langen coal-heating furnaces, with firing in tiers, trisected heating cylinders, and with self-acting withdrawing apparatus, excepting dryer, each with 28 cylinders, with hard-soldered cooling pipes of sheet iron .....per piece..		1,950.00	5,850.00
50	Drying plates for the same, with registers ....per kilogram..	4,500	22.00	990.00
51	3 collecting boxes for the coal-heating furnaces, with slides, each		160.00	480.00
52	2 water-pressure engines, including hooping .....each..		800.00	1,600.00
53	3 coal transport carts.....do....		160.00	480.00
54	All the iron parts to a limekiln, with 3 firings and 3 outlets, including tin case and pipe			2,000.00
55	1 coal-boiling apparatus, with 3 barrels of 1,100¼ and 1,570¼ height in the direct places complete, with all the connecting pipes below them, and valves, metal slides, tinned wire sieves and collecting pipe.....			2,700.00
56	1 double chalk-slaking barrel, with clack valves			320.00
57	1 limewater barrel, with fine wrought-iron grate and valve ..			320.00
58	1 stirring apparatus to the limewater, with wrought-iron barrel.....			300.00
59	1 lime pump of 22 per cent., with rod			375.00
60	1 filling funnel for the filter			30.00
61	1 filling funnel for the coal-boiling apparatus.....			40.00
62	1 exhaust-steam box for the Schützenbach apparatus.....			425.00
63	1 lying working machine with 365¼ and 328¼ lift, with patent regulator, including grappling and closing valve.....			4,000.00
64	1 lying-machine of 300¼ and 525⅞ lift, with patent regulator, including grappling and closing valve for the sugar house..			2,700.00
65	1 lying machine of 235¼ and 525 lift, with patent regulator, including grappling and closing valve for the coal house.....			2,000.00
66	1 machine of 157¼ and 260¼ lift, including grappling and closing valve for the lime station			900.00
67	2 double-working feeding pumps of 100¼ and 200¼ lift, including grappling and closing valve .....each..		1,300.00	2,600.00
68	1 balance water-pumping engine of 365¼ and 785¼ lift, with 2 simple working water pumps of 315¼ and 2 feeding pumps of 105¼, including hooping and valve.....			7,320.00
69	1 balance air-pumping engine of 365¼ and 785¼ lift, with 2 air pumps of 420¼ and 2 heaping pumps of 210¼, including hooping and closing valve			8,580.00
70	Special pipes and air chamber.....per kilogram..	2,400	32.00	768.00
71	2 pump valves of 210¼ each, with 1 section bucket.....each..		135.00	270.00
72	1 carbonic-acid steam pump of 470¼ and 525¼ lift, including hooping and closing valve			4,000.00
73	1 safety valve for the carbonic-acid pump			125.00
74	1 return valve.....			75.00
75	Various valves with red brass cones and spindles, well-finished wrought-iron columns and wrought-iron fillets, 39¼, 52¼, 65¼, 78¼, 92¼, 105¼, 131¼, at 28, 35, 45, 55, 65, 75, 105 marks.....each..			5,000.00
76	14 plugs and fermenting tubs.....do....		10.00	140.00
77	1 simple gin with 125-metre chain and roller, with holdfasts to the same to the lime crane.....			275.00
78	1 gin with double communicator and 12-metre chain, 1 roller with holdfasts to it			375.00

Estimates for sugar manufactory—Continued.

No.	Machinery, fixtures, etc.	Kilograms.	Price.	Total.
	A.—*Machinery and apparatus*—Continued.		*Marks.*	*Marks.*
79	All the cast-iron pipes with turned flanges and bored screw holes in normal lengths ..... per kilogram..	17,500	25.00	4,375.00
80	The same in unnormal lengths ..... do....	2,000	28.00	560.00
81	Special knee and support pipes ..... do....	10,000	32.00	3,200.00
82	8 filters, about 115 to 9,200 kilograms, 5 montages, 1 *retour d' eau*, 3,600 ..... per kilogram..	12,800	31.00	6,528.00
83	Sieves and stands to the filters ..... do....	150	0.75	112.50
	Total A	.....	.....	151,274.50
	B.—*Coppersmith's work.*			
1	*a* 1. Copper vacuum in ball form of 2,040¼, with high dome, double bottom, and double worm of 80, respectively, 105¼ and conus (milling apparatus) of 260¼ ..... per kilogram..	2,750	270.00	7,425.00
	b. All the water, steam, and juice valves in triple positions, per kilogram	250	270.00	675.00
	c. Vacuum barrels and complete conus motion, vacuum gauge, thermometer, glass tubes, eye glasses, and India-rubber conus	.....	.....	675.00
2	1 evaporating apparatus, standing in 2 bodies of together 240 square-metre heating surface, with complete garniture	.....	.....	15,600.00
3	2 condensators for conus injection ..... each..	.....	750.00	1,500.00
4	Filtration to 8 filters, consisting in 8 cast-iron pipes, 8 cast-iron outlet knees, 8 brass air cocks, 8 brass 39¼ knee valves, contra steam, 8 brass 39¼ knee cocks and water, 8 brass 39¼ knee cocks, dam juice, 8 brass 39¼ knee cocks, thick juice, 8 brass 39¼ passage cocks, rising, 8 brass 39¼ outlet valves, with complete copper pipe connection (the pipes below) each	.....	650.00	1,500.00
5	Copper worms and knee ..... per kilogram..	1,000	270.00	2,700.00
6	Straight copper pipes ..... per kilogram..	1,500	240.00	3,600.00
7	Rose copper ..... do....	1,200	225.00	2,700.00
8	Hard solder ..... do....	900	180.00	1,620.00
9	Borax ..... do...	200	180 00	360.00
10	Tin ..... do....	400	200.00	800.00
11	Small copper utensils ..... do....	300	276.00	810.00
12	Wrought-iron plates ..... do....	3,000	100.00	3,000.00
13	Various iron screws ..... do....	.....	.....	1,800.00
14	Various screws with turned heads and brass female screws...	.....	.....	400.00
15	Various brass valves and cocks with red brass cone and cube ..... per kilogram..	2,000	270.00	5,400.00
16	Waought-iron pipes, 32, 44, 57, 69, 82, 95, 108, 121, 134¼, at 1.65, 1.80, 2.15, 2.70, 3.60, 4.15, 5.55, 7, 0.8, 60 marks per metre	.....	.....	9,000.00
17	Tin pipes and drying-stove pans, etc ..... per kilogram..	3,000	100.00	3,000.00
	Total B	.....	.....	66,265.00
	C.—*Other articles.*			
	Leather straps, girths, tin buckets, Schützenbach boxes, screws, India-rubber packings, and other minor articles....	.....	.....	12,000.00
	Recapitulation.			
	A.—Machines and apparatus	.....	.....	151,274.50
	B.—Coppersmiths' work	.....	.....	66,265.00
	C.—Other articles	.....	.....	12,000.00
	D.—Unforeseen things	.....	.....	20,460.50
	Total	.....	.....	250,000.00
	Total in United States gold	.....	.....	$59,590.00

The cost of machinery for a manufactory capable of working up 500,000 kilograms (or 500 tons) daily, will be as follows:

	Marks.
A.—Machines and apparatus	329,271.50
B.—Coppersmiths' work	294,785.00
C.—Other articles	40,000.00
D.—Unforeseen things	35,943.50
Total	700,000.00
Total in United States gold	$142,000.50

About 6 per cent. will be added for seaworthy packing and for delivering on board steamer at Bremen.

J. S. POTTER.

UNITED STATES CONSULATE,
Stuttgart, April 5, 1880.

SUGAR-BEET CULTURE IN EUROPE (1884).

REPORT BY CONSUL WILSON, OF BRUSSELS.

The fact that the manufacture of beet sugar on this continent has, within the last few years, grown into such magnitude and become such an element of national wealth, whilst in the United States it has made such little progress, notwithstanding the comparative cheapness of our land and the peculiar adaptation of much of our soil and climate to the growth of the beet, would seem to imply that our cultivators of this plant have either not yet fully appreciated all the conditions necessary to make its culture a profitable crop, or that for some reason our refiners have failed to render it such for them.

However this may be, I here propose to give, in as brief a form as possible, some practical observations on this subject derived from reliable authorities, which may, perhaps, awaken amongst both our refiners and agriculturists an increased interest in what is regarded on this continent as one of the most profitable of soil crops.

AREA CULTIVATED.

There are now no less than 875,000 hectares, or about 2,000,000 acres, of land devoted to the culture of this beet in France, Germany, Austria-Hungary, Russia-Poland, Belgium and Holland, distributed amongst these countries in the folowing proportions, viz: In France, 220,000 hectares; in Germany, 210,000; in Austria-Hungary, 200,000; in Russia-Poland, 180,000; in Belgium and Holland, 65,000 hectares. For Russia and Holland I regret that I can not furnish further statistics relating to their sugar product; but in France there are now 500 refineries, producing annually about 385,000 tons of sugar; in Germany 341, producing 575,000 tons; in Austria-Hungary 245, with a product of 425,000 tons; and in Belgium 156, turning out annually about 100,000 tons. Thus it will be seen that in the four above-named countries the annual product of this sugar amounts to an aggregate of 1,485,000 tons.

CULTIVATION IN THE SEVERAL COUNTRIES.

Germany, undoubtedly, now stands at the head of the beet-sugar manufacturing nations of this continent, for certainly in no other country of Europe has this manufacture developed with such rapidity or into such colossal proportions; and this is generally attributed not so much to the better adaptation of German soil to the cultivation of the beet as to the mode in which this is done and the enlightened fiscal régime applied to the sugar refineries. In Germany and Austria, and, I believe, in Russia also, the excise duty is assessed upon the beet before it enters the refinery, leaving the manufacturer free to convert this material into whatever form he may find the most profitable; whilst in France, Belgium, and Holland it is assessed upon the sugar produced in the refiner-

ies, to ascertain which Government officials are appointed to watch over every stage of manufacture and to see that nothing goes out of these establishments by night or by day, either in the form of crystallized sugar or any other substance containing saccharine matter, without being first submitted to inspection and the imposition of duty. The refiners of this country are not only subjected to the surveillance of these official agents, but are also required to report to the Government the precise day of each year when they intend to commence refining operations, in order that the inspectors may be on hand; and in case they are not ready at that time they are compelled to pay 15 francs to the Government for every twenty-four hours after that date until they begin operations.

GOVERNMENT TAXATION AND ENCOURAGEMENT.

The mode of assessing the excise duty in Germany gives to the sugar-refiners of that country another very great advantage over the refiners of France and Belgium. The German refiner, instead of having to submit to the annoying interference of Government inspectors in determining the duty to be paid according to the grade of his product, is simply required by law to pay an amount equal to 25 francs per ton on all the beets entering his refinery, and when once their weight is determined and the duty paid the Government has no other claim upon him. But this is not all the superior advantages this mode of assessing the excise duty confers upon him. When it first became a law German beets contained about 6 per cent. of saccharine matter, and the excise duty of 25 francs per ton was based upon that fact; but under the present improved mode of selection and cultivation they contain from 10 to 12 per cent., all of which excess may be fairly regarded as clear gain to him. There is still another feature of this manufacture in Germany that accrues to the benefit of both cultivator and refiner well worthy of consideration. A very considerable number of the refineries in that country are now organized and incorporated as coöperative companies. In other words, the large and small cultivators of the beet in certain districts have built refineries upon the following joint-stock plan, viz: After determining the probable cost of their contemplated refineries, shares of stock are issued, payable in installments, to cover the expense incurred, and each stockholder obligates himself to furnish to the refinery an annual quantity of beets, proportioned to the stock he has in the concern, and as every stockholder obligates himself to furnish to the refinery an annual quantity of beets proportioned to the stock he has in the concern, and as every stockholder, whether large or small, is dependent upon the product of the refinery for quite a portion of the profits of his cultivation, it may be readily imagined that he leaves nothing undone in the way of cultivation to bring his beet crop up to the highest possible standard of both quantity and quality. Indeed, there can be but little doubt that this class of sugar-manufacturing associations

has done more to perfect the beet-culture in Germany than any one other element whatever; and that the Germans have found this a profitable industry I need only here to mention that seventeen new refineries have recently been built, thirteen are in process of construction, and projects are now on foot for the building of no less than fifty more, which will necessitate an increased beet-culture of more than 50,000 hectares. In a recent report made to the German Reichstag, Herr Richter, a deputy from Hagen, made the statement that in 1881–'82 no less than 100,000 tons of beet sugar had been exported from the country, thus escaping 25,500,000 francs excise duty that otherwise would have gone into the public treasury. The remission of this duty to the German refiner on all the sugar he exports is of vastly more importance to him than is a similar remission to the French and Belgian refiner, seeing that it is assessed upon his beets, calculated to contain 6 per cent. of sugar, whilst they really contain from 10 to 12, the value of which difference becomes to him an export premium paid him by the Government. Indeed, it is thought here in Belgium, and in France also, that if to the present number of refineries the new ones contemplated in Germany should be added, within two years the product of German sugar will amount to 1,000,000 tons, and that of this quantity there will be about 600,000 tons available for foreign exportation, which, with their premium-paying excise duty and their superior mode of cultivation, will enable them to largely monopolize the sugar markets of the continent and seriously cripple this industry both in France and Belgium, unless these Governments come to its aid in one form or another.

MODE OF CULTIVATION.

The cultivation of the beet throughout France, but especially in Germany, is being constantly modified with a view to better results, both as to the gross yield of roots and the quantity of saccharine matter they contain. The climatic conditions and chemical qualities of the soil where it is proposed to plant are carefully and scientifically studied, and after these have been found satisfactory the preparation of the soil, class of fertilizers, mode of planting, and the variety of seed selected receive an equal amount of consideration.

On the subject of climatic influence it is an established fact that no locality where the length and heat of the growing season are such as to force the plant into a seed-bearing stem the first year is fit for the cultivation of the beet for sugar, seeing that the rapid development of its organic structure into this degree of maturity always involves a marked decrease of saccharine matter. It would seem from the reports of the most scientific and competent observers that during the early growing season of April and May this plant requires but a moderate degree of both heat and moisture; but in June and July, when it is maturing its foliage and form, a much greater degree of both is necessary; and, finally, that during August and September, the period for the elabora-

tion of its saccharine matter, it requires uniformly dry heat. If much humidity prevails at this season the plant will continue to develop its foliage and become deficient in saccharine qualities and consequently more or less of a failure.

The quality of the soil and the mode of its preparation are also elements of the first consideration in this culture. It is now, I believe, generally admitted that neither a sandy nor a hard clay soil destitute of calcareous matter, nor yet one too highly charged with light, porous organic matter, is favorable to saccharine development in this plant. In short, without entering into a detailed description of the various soils recommended, it may be said that the soil best adapted to the production of wheat and rye in a due proportion of a strong straw and perfect grain will suit this beet well.

But however favorable the climate or naturally well adapted the soil may be, if a due regard is not had to its proper preparation before planting, a good and paying crop can not reasonably be expected. It is a chemical fact that (all other conditions being equal), for the fullest development of saccharine matter in this plant, it must possess a good tap-root and a smooth, well-proportioned form; hence it matters not how rich in proper chemical constituents the soil may be, if it has not been plowed to a sufficient depth to allow the tender tap-root to prolong itself downward it will be forced aside and the plant will at once throw out additional roots to attach it to its base. The downward growth being thus obstructed, the body of the root is unduly pressed above the surface of the ground, and this, with the straggling lateral roots it is forced to throw out, destroys its symmetry of form and invariably results in diminishing the elaboration of sugar in the plant according to its weight. On all successful beet-growing farms on this continent the soil is turned and opened to the depth of at least 20 inches, and this is always done when possible in the autumn preceding the spring planting.

On the subject of the best variety of beet to be selected for planting, it may suffice to say that, whilst the sugar-producing qualities of almost all (and there are many) have been improved within the last few years, it is an admitted fact that there is no variety especially superior to the others in its adaptation to the various soils and climatic conditions of all countries, and that the safest method to pursue in this matter is for each cultivator to grow, from selected plants of known sugar-producing quality, his own seed, and thus secure an acclimated variety suited to his locality. A vast number of methods have also been invented for determining the germinal quality of the seed intended for planting by the cultivator, but a knowledge of the maturity of the seed-bearing plants furnishing the seed and a proper regard to the form and relative weight of the seed will, in most cases, be sufficient to guard the farmer against any errors in this direction.

FERTILIZERS FOR BEET-CULTURE.

The subject of fertilizers for soil devoted to this culture has also claimed much attention from the beet-growers of this continent, and is, I think, now well understood. Formerly it was thought by farmers that a plant so charged with sugar was necessarily an exhaustive crop to the soil, but chemistry coming to their aid demonstrated to them that as sugar was composed of carbon, hydrogen, and oxygen—all derived from the air and water—it was one of the least exhaustive crops they could plant, and such, indeed, is the fact; for if, after the extraction of the sugar, the pulp, with the neck and leaves of the plant, were restored to the soil upon which they grew, there would only remain to be restored to it, of its original constituents, but a small amount of phosphates, lime, potash, and soda, in order to bring it up to its original fertility.

But the question with intelligent beet-growers now is not how they may best guard against an exhaustion of their soil, but how they may secure from it the greatest weight of roots containing the highest possible degree of sugar; and here again chemistry has come to their aid. It has been satisfactorily established that to produce 50,000 kilograms of beet roots, yielding 12 per cent. of sugar, upon a hectare of land, the soil must contain at least 60 kilograms of phosphoric acid, 100 kilograms of lime, 90 kilograms of magnesia, 200 kilograms of potash, and 120 of azotic or nitrogenous matter; but, as all soils contain more or less of these agents, this quantity need not necessarily be added to many of them to secure the above-named crop.

However, as a basis of calculation to serve as a guide to the cultivator, it is assumed that to any given natural soil that will produce 15,000 kilograms of beets, yielding 10 per cent. of sugar, two-thirds of the above amount of fertilizers should be added to secure a yield of 50,000 kilograms of beets of 12 per cent. sugar constituents. Hence, to produce a crop of this beet yielding 6,000 kilograms of sugar per hectare, on a soil previously more or less exhausted, the following formula of fertilizers has been advised, viz: Hyperphosphates of lime, 400 kilograms; sulphate of lime, 200 kilograms; chloride of potash, 250 kilograms; nitrate of soda, 350 kilograms; sulphate of ammonia, 150 kilograms. This is what is here called intensive fertilization, and is now resorted to in some modified form, according to the original quality of the soil or the rotation of crops grown upon it, in all the large beet-growing districts on this continent.

Stable manure, which generally contains a large proportion of nitrogen, is rarely used as a fertilizer for a crop of beets immediately succeeding its application, in consequence of its stimulating too much the growth of organic matter in the plants at the expense of saccharine qualities; but, when wheat or rye is sown in the autumn in a soil thus fertilized, a good crop of beets may generally be expected from it the next year. In the environs of Lille, near the southern frontier of this

country, it is not an unfrequent thing for the farmers, by the free use of this strongly nitrogenous fertilizer, to grow upon a single hectare of land 100,000 kilograms of beets, but the roots, whilst unusually large, are cavernous and spongy and greatly deficient in sugar. Seeing, however, that not only in France, but in Belgium and Holland also, the cultivators sell their beets to the refineries at a price agreed upon per ton and have no further interest in the sugar product, this kind of fertilization continues to be more or less practiced in these countries; but in Germany, and especially among the coöperative cultivators, who have a double interest in their crops, it is generally repudiated, for, as the standard price per ton allowed for their crop is determined by the ascertained quantity of the sugar it contains, they have no motive to raise beets deficient in this matter, and especially as the Government levies a tax equal to 25 francs on every ton of beets that enters the refineries in which they are stockholders, regardless of quality.

MODE OF PLANTING.

Amongst successful beet-growers here there still exists a difference of opinion as to the mode of planting adapted to the product of the best crop, some advocating the sowing of the seed in rows on a flat surface and others on elevated ridges. The latter mode, however, is now the more popular, and is in Belgium almost universally practiced. After a due preparation of the ground, the planting is done by a machine depositing the seed in ridges about 2 feet apart, previously made; and when the plants begin to show well upon the ground they are thinned out, so as to leave from 10 to 12 inches between those intended to remain. Whilst there are many advocates for larger spaces between the rows, and also between the plants in the row, from all I can learn, this plan, in a soil moderately rich, affords ample room for cultivation and produces the best results. The subsequent cultivation consists in destroying all weeds that may grow either between the rows or the plants in the row, and of loosening the soil and banking it up to the plants by small cultivators and plows adapted to the purpose; and the more frequently this is done during the growing season the better the prospects of a good crop will be.

BEET-CULTURE IN THE UNITED STATES.

As the subject of net profit from any kind of agricultural industry is the one which usually determines its adoption or rejection in every country, the question for our American farmers to determine in regard to this cultivation is: Does it pay or can it be made to pay? The answer to this interrogatory involves a number of considerations that must here be mentioned. However good the crops our farmers might be able to raise, they could not profitably dispose of them unless there were refineries to purchase them, and, unless the manufacture of sugar from the beet can be made a profitable industry in the United States,

refineries will not be built; hence the difficulty in attempting to resolve this question.

Of the paying results to the limited number of refineries now in the United States I have no knowledge and therefore can not venture an opinion upon the subject, nor have I any reliable data from which to judge of the profits of the continental refineries, seeing that this is, as much as possible, kept a secret of the craft; but as all beets raised by the farmers are freely bought by the refiners it is fair to assume that the manufacture of sugar from them is profitable, otherwise their cultivation would soon cease.

PROFITS OF CULTIVATION.

The following facts showing the relative yield and value of some of the chief agricultural products of Belgium will, at least, indicate how the matter of profit stands with the farmers in this country. The average yield of wheat, per hectare, is 1,675 kilograms; of rye, 1,460; of barley, 1,830; of oats, 1,500; and of beets, washed and cleaned ready for the refinery, 35,000 kilograms. The average price of wheat is 28.50 francs per 100 kilograms; of rye, 23; of barley, 21; of oats, 19.80; and of beets, from 20 to 25 francs per ton. The estimate will give, per hectare, the following cash values of these respective crops, viz: Wheat, 477 francs; rye, 433; barley, 384; oats, 315; and beets, about 800 francs. Thus it will be seen that a hectare of beets will yield a cash value of 322 francs more than wheat, 367 more than rye, 416 more than barley, and 484 more than oats.

I am not able to give the exact proportionate cost of the cultivation of these crops in this country, but it may be accepted as a fact that the cultivation of a beet crop does not, by any means, involve an increased expenditure of money equal to the increased value of the crop raised over that of any of the cereals just named. From data now before me I fortunately can give an exhibit of the average cost and profit of this crop in Germany, and for this purpose have selected the following figures, taken from an estimate made in the Duchy of Brunswick, where all the conditions of price of land, soil, climate, and cost of labor are probably as well adapted to this purpose as any other.

Expense of cultivating per hectare.

	Francs.
Seed and preparation of the soil	140
Plowing, harrowing, and other cultivation	183
Artificial fertilizers	150
Rent paid to proprietor	150
Total expenses	623

Receipts per hectare.

	Francs.
28,600 kilograms of beets, at 27.50 francs per ton	770
35 per cent. of pulp, at 10 francs	98
Leaves and neck of plants for cattle food, valued at	50
Total receipts	918
Deduct expenses, including rent	623
Balance of profit to cultivator	295

This I doubt not would be as correct an average estimate of cost and profit for this entire continent as could well be made, and with it I leave the whole subject to the consideration of whom it may concern, merely remarking, in conclusion, that if in any country this can be made a profitable industry it ought to, if scientifically pursued, be made so in the United States, where so much of both soil and climate favorable to it abound.

JNO. WILSON,
Consul.

UNITED STATES CONSULATE,
Brussels, February 15, 1884.

MANUFACTURE OF RAW SUGAR FROM BEET ROOTS (1888).

REPORT BY CONSUL FALKENBACH, OF BARMEN.

The beet roots, which have been planted with the object of sugar production, are first of all conveyed, when their leaves have been removed, into the yard of the sugar factory. Here they are thrown into a canal (*a*) provided with descents in brickwork, or with metal gutters, through which they are borne by the rushing water into the washhouse, which constitutes the first stage of the factory.

This beet conduit may be situated with advantage in a building known as the beet-root cellar, or beet-root house (*b*), whereby the beets are protected to some extent from the influence of the weather.

In place of the beet conduit a horizontal belt transporter is sometimes employed, but it must be invariably roofed over. A distinct advantage of the beet conduit over the transporter is that in the former the beets are not alone transported but also freed in the water from a portion of the impurities attaching to them without any being incurred.

These conveyers, whether of mechanical or hydraulic construction, bring the beets, as above stated, into that chamber of the sugar factory—the washhouse—which is utilized solely for washing purposes. The washing of the beet constitutes a very important element in the manufacture of sugar, for the beets are thereby freed from mold, small stones, and other kinds of dirt attaching to them, and in consequence not only is the machinery employed in the actual preparation of the beets preserved from injury but the sugar ultimately obtained is kept free from

impurity. So soon as the beets have been brought into the washhouse they are thrown into the washing machine by means of a raising wheel or a chain pump, or through a spiral passage (*c*) placed aslant. The last-named method has this special advantage, that it serves to wash as well as to convey the beets, and permits of the raising within an hour both the beets and water in which they are contained.

There are two kinds of washing-machines, the drum-washer (*d*) and the bar-washer (*e*). The former consists of a cylinder rotating upon its own horizontal axis; the latter of an arm, or bar, likewise turning on its own horizontal axis. Both are mounted in a trough provided with cocks for admitting and leading off water, and in both there is a stone-catcher.

In the washing apparatus the chief aim is to bring the beets as much as possible into contact with pure water, so as to be washed clean. The dirt and stones detached from the beets are deposited on the floor of the stone-catcher, or receiver, fixed to the back part of this machine, from which they are from time to time emptied out from below; the beets, however, are conveyed by a contrivance constructed for the purpose from the washing apparatus into the stone-receiver, by the arms of which their further transport is effected. The greater the area of the wash-machines the more thoroughly are the beets cleaned. It is advisable, therefore, to have two washing-machines placed one after another, and best of all two bar-washers, or one bar-washer and one drum-washer.

In order to reduce the consumption of water in the sugar factory to the lowest possible figure, the water condensed from the steam given off from the boiling apparatus in the factory is utilized for the purposes of the conduit and washing the beets.

The employment of this condensation water, which has a temperature of about 35° C., adds considerably to the effect produced by the washing machine, and is quite indispensable when frozen beets have to be washed. In case the quantity of condensation water obtainable should prove insufficient it must, of course, be supplemented by the addition of fresh, cold water.

With the mere washing of the beets the manufacturer is not content; provision is therefore made for the beets to be freed from those parts which are poor, or at least not so rich in sugar as the others, before the process of extracting the juice begins. With this object the greenish upper part of the beet is cut away. This measure is of great importance in Germany, for in that country the tax paid to the State by the sugar manufacturer on his productions is assessed on the weight of the beets, so that he would be obliged to pay on the same scale for the portions which contained but a poor percentage of sugar as for the rest. In other countries, where the method of taxation is different, less importance is laid upon the removal of the green beet tops, and these are manufactured with the whole remaining portion.

For the purpose of removing these tops and the pebbles and dirt which may have been torn up with them, as well as any rotten parts which the beet may contain, a caroussel (*f*), or broad transporter, is placed so as to receive the beets, which are thrown into it from the washing machine by means of the arms of the stone-receiver. This transporter is of wire and moves at a low rate of rapidity, so that the workwomen beside it can cut each beet and, as far as they are able to see, to remove with facility the rotten parts, the small stones, and all foreign bodies. The caroussel is a circular sieve placed horizontally, through the apertures of which the water, of which a certain quantity is thrown in from the washing-machine, may run out. Around this caroussel, which moves very slowly upon its center, workwomen are also placed and perform exactly the same work as in the case of the transporter above mentioned. After passing under this thorough revision the beets are conveyed automatically from the caroussel to a perpendicular or slanting chain-pump (*g*), which provides for their passage from the wash department to the diffusion chambers.

The waste, which the workwomen have separated out, is invariably put aside. There two kinds of chain-pumps, the dredge-pump and the chain-elevator, both of which consist of a number of cup-like vessels, which receive the beets from the caroussel and deposit them in a box called the beet-collecting box. They are distinguished from one another only by the kind of connection—belt or chain—between the different cups. The term collecting box is sufficient to explain that the beets are collected in this receptacle when the washing process is complete. Thence they are conveyed by separate lots in trucks running upon rails over a weighing machine (*h*), there weighed, and then drawn to the cutting or slicing machine (*i*), into which they are transferred.

In Germany the weighing of the beets takes place under the control of the revenue authorities, and is to be recommended for factories in countries where a different system of taxation, or none at all, prevails, for solely by this means is the sugar manufacturer enabled to ascertain the exact quantity of beets manufactured each day. Only the approximate weight of the beets can be arrived at by weighing them as they come from the field. Dirt and all other impurities removed during the washing process are, of course, valueless, but often amount to 30 per cent. of the weight of the beets. A previous weighing can, therefore, only serve the purpose of fixing the original weight of the quantity of beets employed for the sake of estimating the price. With the above mentioned cutting-machine we have reached one of the principal stages of actual sugar manufacture, namely, the point at which the process for obtaining the juice comes under consideration. The system most generally adopted, and the one solely employed in new factories, is called the diffusion system (the manipulation of the beet root in slices), and is the only one which we propose to consider now.

As the sugar juice, which it is intended to obtain, is contained in the

cells of the beets, it is necessary to bring as many of the cells as possible into contact with water ,so that the latter may dissolve out the juice, an effect which is rendered possible by applying the process of diffusion to the beets after they have been cut up into slices. The laying bare of the interior cells of the beets, which is produced by cutting the beets up into thin slices or lumps, is effected mechanically, namely, by means of the slicing-machine, which is thus seen to be one of the chief factors of the diffusion system. The slicing-machine consists of a disk, rotating horizontally on its own axis, and fitted with knives. By means of the rotation the knives catch the beets which descend upon them and cut them up into thin circles. The slices slip down beneath the knives and fall into a transporter placed to receive them. The most celebrated and therefore the most generally employed cutting-machines are either stationary or depending, and driven by transmission gearing. Other kinds are known, but these are of inferior excellence.

The knives employed are of very various construction, such as rib knives, goller knives, roof-rib knives, anchor knives, etc. If the beets have not been properly washed, and foreign, hard bodies, such as iron, stones, and such like, are brought into the cutting-machine, its knives are seriously damaged. These must then frequently be changed and sharpened and an interruption of the factory operations is the result. The cuts are also rendered bad thereby; they become irregular in shape, and it may be said that the diffusion suffers in consequence from indigestion. Hence the warning which must be given to expend as much care as possible upon the beet wash-house. The transporter into which the slices fall from the cutting-machine is called the filling transporter (*j*), as it serves to fill the diffusion vessels. This filling transporter is so arranged that one or the other of the diffusion vessels can be filled at will (in correct manufacture by rows), and is constructed of either a straight or a circular shape, according to the arrangement of these vessels.

We have now come to the diffusion vessels, but before entering upon a detailed description of them we will first explain the nature of the diffusion which takes place in them. By diffusion, or osmose, is understood the process of exchange which goes on between two different kinds of fluids of unequal degrees of density, contained in two different vessels, connected by a membrane. This diffusion, which takes place through a membrane, is called membrane diffusion, to distinguish it from free diffusion, which takes place freely, that is, without any membrane.

The beet juice is contained in the cells of the beets and each one of these cells is covered by a membrane. In this case, therefore, a membrane diffusion between two fluids—the juice in the cells and the water in which they are rinsed—is the only diffusion possible. In the case of the sliced beets, the large quantities of cells contained in them must be considered, the process of diffusion being here somewhat different than when only a single cell is concerned.

In order to comprehend the process, let us imagine a number of cylinders tightly closed together on their circular surfaces, and with their contents for the present moment separate. This complex of cylinders, which are filled with juice, is hung in a vessel filled with water. The diffusion naturally takes place, first of all, with the two extreme cylinders, and then gradually advances from both sides towards the middle, until the juice in all the cells or cylinders has acquired, by means of exchange, the same density as the surrounding fluid in the vessel (originally water). When this has taken place the diffusion is at an end, but it can be repeated after the whole of the fluid, now of the same density, has been drawn off. In this way the cylinders can be lixiviated by constantly changing the fluid: also, new and additional complexes of cylinders can be lixiviated, when the drawn-off fluid is repeatedly re-employed. In the latter case a higher density or concentration of the drawn-off juices is obtained. By this method the saccharine juice is extracted from the sliced beets. If now, instead of the vessel filled with water, a diffusion vessel be imagined, and, instead of the cylinder filled with saccharine juice, the cells in the sliced beets, which are conveyed from the cutting-machine to the diffusion vessels in the filling transporter, we have a mechanical explanation of the entire diffusion system.

Temperature is a most influential factor in the diffusion process, for the higher it is the more rapid is the diffusion. At the same time it is not advisable to exceed certain proportions. In order to preserve the required temperature in the vessels in which the diffusion is taking place, fore-heaters, or calorisators, are employed.

It is not the object of these lines to describe in the minutest detail the nature of the diffusion, so that, after the above brief explanation, we turn back to the point at which the sliced beets are supposed to arrive in the diffusion vessels.

The diffusion apparatus (*k*), or, to put it shortly, the diffusion, consists of ten to twelve vessels (the diffusers), as many fore-heaters, or calorisators, and the necessary valve and tube fittings.

The complete diffusion apparatus is called the diffusion battery, and this can be constructed, according to arrangement, with vessels in one or two rows, or in a circle. If the diffusion battery is of one or two rows, the shape of the filling transporter is straight, and the cutting-machine can be placed at the side of the battery. In case of circular diffusion, the filling transporter must also be circular, and the cutting-machine is placed either inside or outside the circle of the vessels, or in the center, in which case it is rotatory on its axis and fills each diffuser itself, so that a filling transporter is superfluous. In rare cases the entire diffusion battery rotates round the cutting machine.

The diffusers are cylindrical vessels placed in a vertical position, with water-tight and hermetically-closing covers. In their upper apertures

slices are thrown in from the filling transporter, and thus the diffuser is filled. Below, the diffusers are closed either by an hermetically-shutting lid or manhole, to empty the vessels of the lixiviated slices when the diffusion is completed. The filling of a diffuser with fresh slices lasts from 7 to 10 minutes, according to its size. With a battery of twelve vessels, one is always being filled and one emptied, while the remaining ten are operating. The diffused juice (about 60 per cent. in volume of the contents of the diffuser) is obtained by adding fresh, pure water under a pressure of one to one and one-half atmospheres to that diffuser which is about to be emptied. The water is drawn from a reservoir (*m*) high enough to produce the required atmospheric pressure, and into which it is raised by means of a water-pump (*l*). By separating out, by means of a compression pump (*m i*) applied from the last diffuser but one, the juice collects and leaves the diffuser, which is being filled with fresh slices, with a condensation of about 11 degrees Brix, and at a temperature of about 30 degrees C. This temperature is attained by the application of a system of pipes filled with steam. In these pipes circulates the juice, which streams through from diffuser to diffuser, and which is thus previously heated. These pipes constitute the above-mentioned fore-heaters, and the extent of their heating surface is in accordance with the length of time consumed by a diffuser in acquiring the necessary grade of warmth, and the extent of the difference of temperature between the steam and the juice.

In the first six diffusers the juice is always maintained by fore-heating, at a temperature of about 70° C., but from this point the temperature declines, so that the last diffuser which is emptied has a temperature of about 30° C., and can therefore be manipulated.

The quantity of juice drawn off from time to time is always a constant one. Continuing its journey, this diffusion juice arrives in a fore-heater (*n*), in which it is heated to 60° or 50° C., by steam produced in the last vessel of a steaming apparatus, which we will describe on a subsequent occasion. After this the juice arrives in a second fore-heater (*o*), which is heated with the spent steam of the steam-engine, and is there heated to 90° C., and is then conveyed into a measuring cask (*p*).

Before passing on to the further process of manufacture, to which the juice now obtained is subjected, we will turn back once more to the diffusion battery, in order to follow the road which is taken by the residue remaining over from the diffusion.

The juice having left the diffusers, the latter contain only the lixiviated slices, which have been deprived of the greatest portion of their juice. By opening the lids or manholes at the bottom, the slices are emptied out of the diffusers, and this operation takes place in the same order as the previous lixiviation. The diffusers are also rinsed out and filled with fresh slices. The lixiviated beet slices, which fall below, are received either in a brick gutter placed aslant and washed

into the slice-presses by the water pouring out with them, and in which they have been rinsed, or they are received on a transporter (*q*), the shape of which is in accordance with the construction of the diffusion battery, and which, from time to time, runs beneath it and conveys away the slices to the presses.

If the presses are not set up immediately beneath the diffusion battery, but above it, the slices must be conveyed by means of an elevator (*r*) from the battery to the presses. There are various kinds of slice-presses, the construction of which differs. They all, however, have the object of separating, as much as possible, the water contained in the slices, and which amounts to about 95 per cent., so that the slices may be utilized as fodder for cattle. The water extracted by the presses is not supposed to contain more than 3 per cent. of sugar. If it should be proved that the percentage is higher, more care must be expended on the diffusion process, and either a better lixiviation of the slices must be effected or the water remaining over from the previous lixiviation must be retained in the diffusers and the latter filled with fewer slices.

Latterly it has been found possible to dry the lixiviated slices very thoroughly by a means of a slice-drying apparatus, the employment of which has proved highly profitable. The quantity of matter resulting from the drying process has thus been raised to its maximum, an effect not previously attainable by means of the presses. The drying of the slices has raised their value considerably as fodder, for the surplus water which they would otherwise contain interferes with the nourishment of the cattle; moreover, wet slices easily become rotten.

Let us now return to the diffusion juice, which we had accompanied as far as the measuring cask and there left. In the measuring casks a fixed quantity allotted one diffuser is measured off and allowed to run out for saturation. Saturation, or separating out, consists in the treatment of the diffusion juices with lime and carbonic acid, whereby the nonsaccharine substances are partially precipitated and partially decomposed, the remainder being preserved unaltered in solution. These nonsaccharine, *i. e.*, foreign, substances are present in the juice in considerable proportions and interfere with the crystallization of the sugar, which they can, in fact, actually prevent; and for this reason pains must be taken to remove them from the juice.

There are three processes of saturation. For the first saturation (*s*) the diffusion juice is brought from the measuring cask at the same temperature as that obtained in the foreheaters, through which it has already passed. It is then mixed with the milk of lime of a concentration of 20° Beaumé, in the proportion of about 2½ per cent. of lime to 97½ per cent. weight of the beets. The action of this milk of lime is to decompose the juice and to combine with various organic substances (nonsaccharine), which are thereby separated out from the sugar juice. The lime is immediately afterwards precipitated by means of carbonic

acid, whereby a certain quantity of nonsaccharine substances are mechanically precipitated, too, and the fluid, originally thick and clouded, becomes perfectly clear and bright. The first and also the two subsequent stations are conducted in a number of circular or polygonal vessels.

The process of saturation being complete the juice is drawn through sand-catchers (*t*) by means of a lye pump, which conveys it under pressure into the filter presses (*u*) of the first saturation, where the precipitated substances or lye is received.

The filters, or lye presses, are classified according to their construction as chamber and frame filter presses. They consist of a number of four-cornered plates (in the case of chamber presses) or of plates and frames (frame presses), over which cloths are stretched. The lye is deposited between the plates or in the frames, while the fluid passes through the cloths before leaving the press, and is thus filtered. This juice as it flows out passes through foreheaters, in which its temperature is raised to about 25° C. preparatory to undergoing second saturation (*v*). It is then treated once more with milk of lime in the proportion of about 1½ per cent of lime to the beets, then saturated, and afterwards drawn once more through a sand-catcher by means of a second lye-pump (*w*), and pressed into the filter presses of the second saturation. There the juice passes through exactly the same process as in the first presses and flows out to undergo the third saturation (*y*).

Previous to the third saturation the juice is warmed by means of foreheaters to about 15° C. and then treated in the saturators with sulphurous acid, which is obtained by burning sulphur in special sulphur-kilns, constructed near to the saturators, and which is forced into them by means of a pump. After the third saturation the juice is conveyed, by means of a third lye-pump, through a third sand-catcher (*z*), and then forced into the filter-presses of the third saturation. There the precipitate is also deposited as lye, while the juice left over is raised at a concentration of about 9° to 10° Brix into a reservoir (B), placed above, for containing the diluted saccharine juice, by means of a pump (A) specially employed for this purpose.

The lye which has been left behind in all the three filter presses is first of all washed in clean water under pressure from the same reservoir used in the process of diffusion. This water is then added to the juice contained in the diffusers and undergoes the same process to which the juice is subsequently subjected, or it is conveyed by means of a small pump direct into the reservoir in which the diluted juice is contained. The lye contained in the presses is subsequently submitted to an evaporating process, but this measure is not absolutely necessary. The presses are opened and the lye transferred from them on a small carriage running underneath or in a transport worm to the lye-wagon, or it is thrown down the lye transport-worm and then removed from the factory. The lye still contains at this stage about 5 per cent. of

sugar and constitutes a serviceable product in agriculture as a fertilizer. Among its component parts are phosphoric acid, albumen, and a quantity of lime. The question now presents itself, how do we obtain the required milk of lime and carbonic acid?

These two products are obtained together from a limekiln (*C*). This limekiln consists of a hollow circular chamber of incombustible material, provided with furnaces and delivery apertures, and is generally placed in the open air in the factory yard, or in what is known as a "closed building." The lime and the carbonic acid are obtained in this kiln by calcining limestone (or chalk). The limestone destined for this purpose is drawn up in an elevator (*D*) to the highest point of the kiln or "mouth," as it is called, and through an aperture in this mouth, provided with a lid, is thrown into the kiln alternately with quantities of coke. The coke is added to accelerate the calcination of the limestone. By means of this calcining process the carbonic acid, also obtained as a lye product, collects in the uppermost parts of the kiln mouth and is pumped out by means of an air-pump, which is known as the carbonic acid gas-pump (*E*), and which is placed inside the factory.

The pump-conduit, which connects the pump with the kiln, passes on its way through a washing-vessel (*F*), the object of which is not only to cool the carbonic acid, but to free it from all impurities with which it may be mixed, such as dust, but above all from sulphurous acids. The carbonic acid gas obtained from the limekiln is mixed in the proportion of about 23 per cent. of pure carbonic acid with large quantities of nitrogen, superfluous air, sulphurous acids, and steam.

The washer is a cylindrical or conically-shaped vessel, filled to about half of its depth with water, above which there is a perforated plate supporting pieces of limestone. The carbonic acid gas is conveyed through a small tube into the water, and when it has passed through both the water and the sieve it is pumped, by means of a carbonic acid gas pump, through a desiccator, in which the water caught up in the washer is retained. The gas is then pressed into a receiver and thence transferred to the saturators.

The calcined, or quicklime, is drawn off in strata from the openings at the bottom of the kiln and allowed to cool in the open air. As soon as possible, when cooled, the lime is slacked with pure water, and with the aid of a lime-slacking apparatus (of various construction), the resulting milk of lime (at about 20° Beaumé) being passed through a sieve, which retains the impurities. The milk of lime is then transported, by means of a pump, to vessels specially placed for its reception above the saturators. The diluted juice, which we left in the reservoirs, is there warmed by steam, and is then run into the evaporating apparatus (*G*). In the evaporating apparatus the concentration of the diluted juice is carried out; for, after the diffusion, this juice has been diluted to about 9° or 10° Brix by the addition of the milk of lime and the sweetened water from the filter-presses. The temperature of the juice,

when it arrives in the evaporating apparatus, where it receives a temperature of 50° Balling, is about 75° C. The concentration of the diluted juice is effected by evaporating the water which it contains.

The evaporating apparatus consists of one or more vessels, according as its effect is single, double, triple, or quadruple, etc. The more vessels there are in the evaporating apparatus the more economically it works; that is to say, the greater is the economy of steam. Not alone, however, does an economy of steam result from employing the greatest possible number of vessels, which, of course, represents the maximum heating surface, but there is a further and consequent economy of coal in the boiler-house, while the heating of the apparatus is effected mainly by slightly rarefied steam of about 1½ atmospheres, and also by the spent steam from the steam engines. The steam, moreover, which proceeds from the boiling juice in the first vessel, serves to heat the second vessel, and so on through the entire series. Owing to the decrease of pressure in the evaporating apparatus, the boiling point is lowered. Water which boils, under normal conditions, at 100° C., boils at a lower temperature when the pressure upon it is less. If it be desired to keep the boiling point constant, the pressure of the increasing concentration of the juice must be lessened. As an example for illustration let us take the quadruple effect. In a quadruple effect, about a quarter of the quantity of water contained in each vessel is evaporated; in the case of a triple effect, one-third, and so forth.

It is thus seen that the concentration increases from vessel to vessel, and in the particular instance we are discussing reaches its highest point—50 per cent. Balling—in the fourth vessel. The steam produced by the evaporation of the water in the first vessel streams into the heating chamber of the second vessel, which it heats, at the same time that a portion of the water of the juice (as already stated, about the quarter of the total quantity of water to be evaporated) is likewise converted into steam. This steam heats the chamber containing the second vessel, evaporates the water again, and the resulting steam finally heats the fourth vessel, whence the steam produced by the repeated evaporations is let free. The first vessel, however, is heated with steam of about 1½ atmospheres.

The vapor produced by the evaporation of the juice in the first, second, third, and fourth vessels, and so forth, leaves the last (in the special case considered above the fourth) vessel at a temperature of 60° C., and can be economically employed for heating the first fore-heater, through which the diffusion juice passes previous to saturation. The vapor can then be condensed. The juice, which has attained to a certain concentration in the first vessel, is then drawn off into the second, then into the third, and finally into the fourth vessel, where it is concentrated to 50 per cent. Balling, and henceforth known as concentrated juice.

The quadruple effect here described, inclusive of the heating of the

first fore-heater, which receives the diffusion juice by means of the vapor proceeding from the evaporating vessel, is a very simple affair. Highly complicated combinations may, however, be arranged, and it is possible to further utilize to some extent the vapor proceeding from the first, second, third, and fourth vessels of the quadruple apparatus which we have been describing, and even to employ it according to need or desire for fore-heating or evaporation—that is to say, decoction. The construction of these evaporating vessels is of various kinds. As a rule, however, they consist of cylindrical vessels, either in a vertical or a horizontal position, and provided with a system of heating pipes. Latterly the Wellner-Felinck system has been most generally employed, and its capabilities have as yet been unsurpassed by any other system. In this apparatus the vessels are of a box shape and are fitted with horizontal heating pipes. As an example, it may be stated that one square meter heating surface in a quadruple apparatus of this system suffices to evaporate 22½ kilograms of the water contained in the juice in one hour, while with other evaporating apparatus the maximum weight is 17 kilograms. In order to evaporate 100 kilograms of water from the juice 26¼ kilograms of steam are required by the Wellner-Felinck apparatus.

It is clear, then, that with this apparatus the greatest economy in steam and, therefore, in the coal required for the boiler is, up to the present date, attainable.

The steam which streams through the heating system of the various vessels in any kind of evaporating apparatus is invariably condensed to water. In order, therefore, to prevent this condensed water from filling up the entire heating system in the course of time and thus hindering the heating surfaces from operating, some means must be found for getting rid of this water, and this is done in the following manner:

From the first vessel of the evaporating apparatus, whether the latter produce a quadruple or a triple effect, the condensed water obtained from the spent steam or direct from the boiler steam passes into a tightly-closed receiver, in which all the remaining waste water from steam of approximately the same expansion throughout the entire sugar factory is collected. This receiver is known as the waste-water tank, and is provided with an automatic or ball cock, which regulates the outflow of water and any accompanying outflow of steam. The water collected in this waste tank is conveyed by means of a pump into the feed-water tank, and being at a fairly high temperature serves for feeding the steam-boiler. From each of the other vessels of the evaporating apparatus the condensed water flows into a special vapor receiver, is thence pumped through a ball cock (*H*) valve (to prevent any steam coming, too) into a reservoir, and may then be employed for slaking lime, for feeding the boiler, or, finally, in the beet conduit, and for washing the beets.

The evacuation of the heating system in the evaporating apparatus

is effected by means of small tubes leading from one vessel to the other and connected with the condenser. The vapor receivers are also evacuated by means of small tubes and the air contained in them is also passed into the condenser.

The evaporating apparatus itself is freed of air by the aid of an air pump (*I*), which is required for bringing the juice to a boil at a lower temperature than 100° C. The air pump, however, is not connected directly with the evaporating apparatus, an additional vapor receiver being inserted in the exhaust tubes, in which the vapor from the other boiling apparatus—which still remain to be described—collect, together with the vapor from the evaporating apparatus, and pass into a condenser. Here they are condensed by the injection of cold water from the reservoir, which was previously made use of in the diffusion process. This condensed water is employed in the initial stage of manufacture for washing and conveying the beets, and possesses a temperature of about 35° C. The condenser is connected with the exhaust pipe of the air pump, while the force pipe of the latter machine puffs out, into the open, air which the pump has withdrawn.

There are two kinds of condensers, the wet and the dry, which differ from each other by their construction and their application. The air pump which operates with the wet condenser is also called the wet-air pump, while the dry condenser is in its turn connected with the dry-air pump. The wet condenser is situated close to the air pump, at the upper end of the factory, and sucks in the interjection water it requires from a maximum depth of 6 metres. In this case, however, the air pump is employed for getting rid of the injection and condensed water and of the noncondensed gases. As it is the part of the air pump to dispose of all the water, the wet condenser can be employed in cases where this water can find no further vent. If, however, the water does not find a vent, the dry condenser must be employed. In this case the condenser is placed in an elevated position. Water is injected into it which condenses the vapor from the juice, while the noncondensible gases and air are drawn off by the dry-air pump, which takes up no water in this instance. The condensed and injected water leaves the condenser through a pipe which leads down into a waste-water tank, and may then be utilized, as already stated, for washing and conveying the beets. The dry condenser must be placed at least 10 metres above the waste-water tank.

The juice contained in the last vessel of the evaporating apparatus (in the case we have assumed, the fourth vessel) and concentrated to 50° Balling is called concentrated juice or sirup, and is raised, by means of a sirup pump (*K*), to reservoirs (*L*) placed high up, and there kept warm by means of steam. From these reservoirs the sirup flows into the sirup presses (*M*), which are of a similar construction to the lye presses already described, or, in place of presses, the sirup may be run through filter bags and filtered. After the filtration the concentrated

sirup flows into a special reservoir, whence it is drawn off, either direct from the vacuum apparatus or from the first boiler. The sirup presses must be placed about three metres below the reservoir containing the unfiltered sirup.

For the purposes of explanation we will take the case in which the concentrated sirup passes into the first boiler, or fore vacuum as it is called, and then into the vacuum apparatus. The first boiler consists of a series of vessels of the same kind as those of the evaporating apparatus, and serves, by means of the use and economy of steam, to further concentrate the juice which actually passes into the vacuum boiler. It constitutes, therefore, a sort of fifth vessel, supplementing the quadruple effect of our evaporating apparatus. This first boiler, however, is not heated by the steam proceeding from the fourth vessel of the evaporating apparatus. It receives a portion of the vapor which passes from the third to the fourth vessel. As, however, an extra quantity of vapor is required for this purpose, more water must be added in the necessary proportion to the first three vessels of the quadruple evaporating apparatus, and the latter must possess correspondingly large evaporating surfaces.

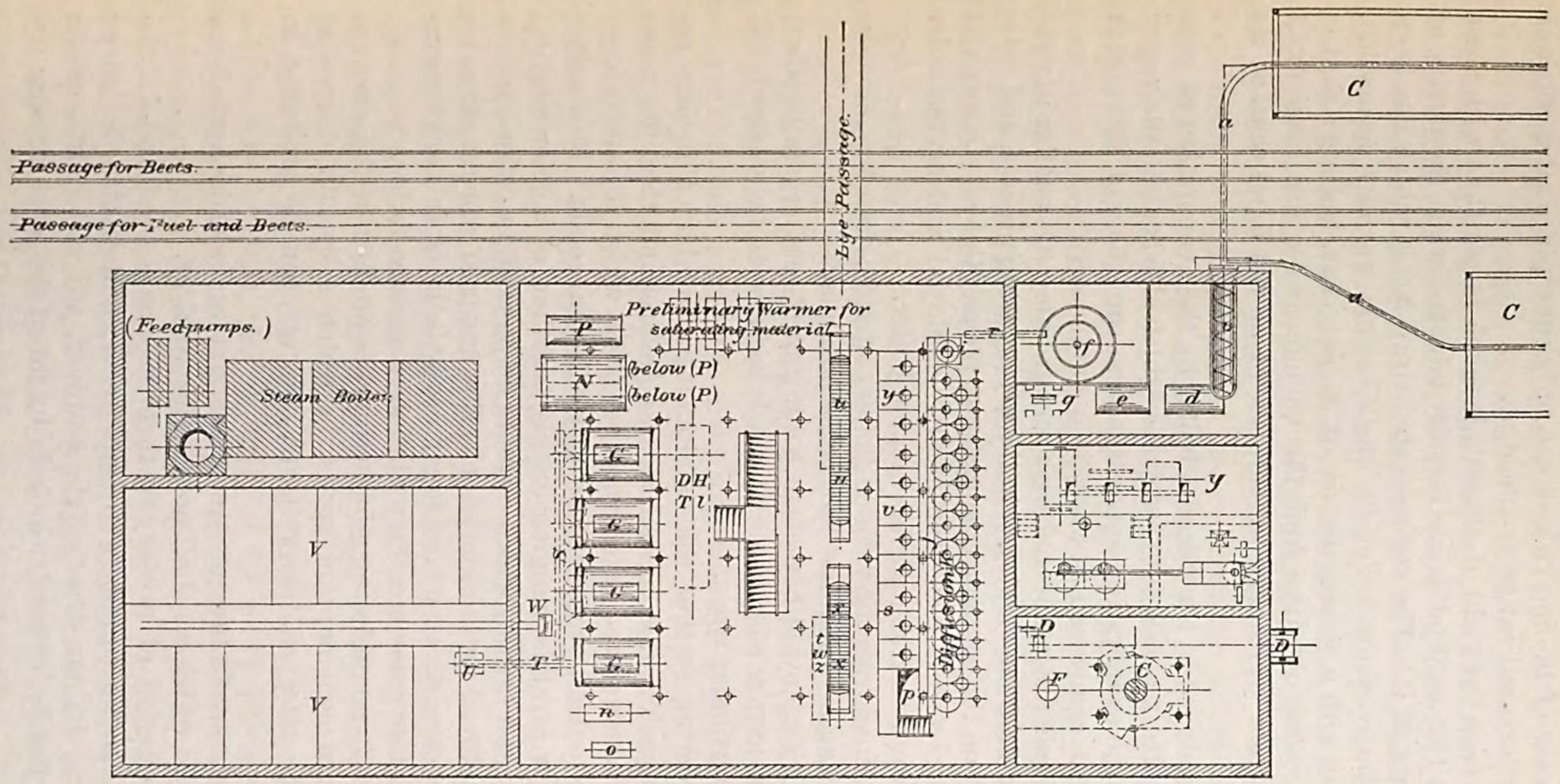
In this case each vessel of the quadruple apparatus will not have merely to evaporate about a quarter of the water in the diluted juice, but the first three vessels will have to evaporate a large proportion. From the reservoir the filtered concentrated sirup now passes into this "first boiler" at a concentration of 50 per cent. Balling. It receives the name "Concentrated sirup No. 1," and undergoes a further concentration to about 63 per cent. Balling by evaporation of water.

When the sirup has attained to this degree of concentration it is drawn off by means of pneumatic suction direct into the vacuum-boiler, or is transferred by means of a second concentrated sirup-pump to the reservoir set apart for "concentrated sirup No. 2," and is thence conveyed to the vacuum boiler. The vacuum boiler (N) consists of a vertical, cylindrical, or ball-shaped vessel, with a conical base, containing heating worm tubes. Latterly vacuum boilers have also been built of a box shape, with horizontal heating tubes (Wellner-Felinck system).

These boilers can be heated with steam obtained direct from a steam-boiler, with spent steam, or vapor from the evaporating apparatus in various combinations, according to the distribution of the entire evaporation. The object of boiling the juice is for the sugar to separate out in crystalline form. The product of the boiling may either be "clear" or in crystals. This depends on the purity of the concentrated juice. By "clear boiling" is understood the production of a thick sirup, which only deposits crystals when it has been removed from the vacuum boiler and allowed to cool. During the boiling process the sirup is perfectly clear. If the concentrated juice has been badly filtered, a quantity of nonsaccharine matter is retained in it. In this case clear boiling is the sole process possible, as a direct crystallization

PLAN OF A SUGAR FACTORY

Consuming 6,000 centners of beets in 24 hours. Built at Grevenbroich, Rhenish Prussia.



Passage for Lime, Coke and removal of sugar.

a Canal; *b* Beet-root house; *c* Spiral passage; *d* Bar washer; *e* Drum washer; *f* Caroussel; *g* Slanting chain pump *h* Weighing machine; *i* Slicing machine; *j* Filling transporter *k* Diffusion apparatus; *l* Water pump; *m* Reservoir; *m*1 Compression pump; *n* Fore-heater; *o* Second fore-heater; *p* Measuring cask; *q* Transporter; *r* Elevator; *s* First saturation; *t* Sand-catcher; *u* Filter-presses; *v* Second saturation; *w* Second sand-catcher; *x* Filter-presses; *y* Third saturation; *z* Third sand-catcher.

A Pump for diluted juice; *B* Reservoir; *C* Limekiln; *D* Elevator; *E* Carbonic acid gas pump; *F* Washing vessel; *G* Evaporating apparatus; *H* Pump for diluted juice; *I* Air-pump; *K* Sirup-pump; *L* Reservoir; *M* Sirup-presses; *N* Vacuum-boiler; *O* Air-pump; *P* Refrigerator; *Q* Movable basin and suspension line; *R* Transport-worm; *S* Transporter; *T* Elevator; *U* Sieve; *V* Reserve receptacles; *W* Mash machine; *X* Centrifugal machines; *Y* Steffen'sche separating process.

of the sugar can not then be effected. If, however, crystals are formed during the process of boiling (which can only take place after efficient filtering), direct crystallization is aimed at.

In the latter case the yield of crystals is much larger than with clear boiling, so that this method is universally adopted when the purity of the juice permits of it. The concentrated sirup No. 2, which has been conveyed into the vacuum boiler (in the example we have assumed), leaves the latter with a concentration of 95 per cent. Balling; that is to say, that the mass obtained from the vacuum boiler has been fixed by the evaporation which has taken place of all but 5 per cent. of its water.

The steam produced in the vacuum boiler by the evaporation of concentrated sirup No. 2 passes into receivers, which also contain the vapor given off from the evaporating apparatus, and the whole of this steam and vapor is then condensed to water in a condenser.

The vacuum boiler is connected with an air-pump (O) similar in construction to the first one employed in the evaporating process, and both of these operate on the common condenser above mentioned. A general air-pump of large size is also occasionally employed and serves both for the evaporating station and the vacuum boiler.

The mass obtained from the vacuum boiler contains, therefore, already 95 per cent. of sugar, which has now to be obtained.

It is open to employ either clear boiling or direct crystallization, according to the nature of this mass, which has also to be manipulated in one of two particular ways.

Before considering further the manipulation to which this mass requires to be subjected, it is as well to state beforehand that the mass can either be manufactured into raw sugar (with which it is the object of this treatise to deal) or direct into consumption goods. Raw sugar consists of sugar crystals hanging loosely together, of a color varying between yellow and brown, which have to be purified or refined before they can be employed for consumption. The sugar of consumption, on the other hand, consists of white sugar crystals in close conglomeration, and comes into commercial circulation in various forms.

Not always is it possible to manufacture the product of the vacuum boiler direct into consumption goods, in which a certain degree of purity has to be attained. Raw sugar, however, can be produced in any case.

It is with the manufacture of raw sugar that we have hitherto been concerned and to which we shall now limit ourselves.

For the production of raw sugar, then, the mass produced in the vacuum boiler can be equally well employed, whether clear boiled or crystallized out. In our description, however, we will only concern ourselves with the latter case, which is by far of the most general occurrence.

The mass obtained from the vacuum boiler is first of all placed in a re-

frigerator (P), which consists of a trough provided with a stirrer and a refrigerating jacket. This construction is of the latest and most approved kind. The mass, or rather the sugar crystals of which it consists, must now be separated from the sirup, so that raw sugar may be obtained, and this is effected in the following manner: The mass is transported in quantities at a time from the refrigerator into a movable jar (Q), or onto a horizontal transport-worm (R), and then conveyed to the centrifugal machines. A centrifugal machine consists of a cylindrical drum, over which is stretched a finely perforated sieve, and which rotates with great rapidity on its own axis. The mass placed in the drum is pressed against the sieve by the action of centrifugal force, and the fluid sirup escapes through the small apertures.

There are various kinds of centrifugal machines. In respect, however, of the safety afforded to the workmen engaged on the machine, apart from its intrinsic excellence, the Panzer, or armored centrifugal, is the best. For preventing accidents, which may be caused by overloading the drum, this part of the machine is so constructed that it may be emptied from the bottom, whereby its capabilities are also somewhat increased.

The sirup having been disposed of, the yellow sugar obtained is called the "first product," and this, having been emptied out of the drum, is placed upon a transporter (S) running horizontally, which conveys it to an elevator (T), by means of which it is transferred onto a sieve (U), where it is freed from lumps which it may contain. The raw sugar is then packed in sacks and sold for manufacture into consumption goods. As a rule, about 68 or 70 per cent. of raw sugar is obtained from the mass produced in the vacuum boiler.

A commencement is now made with the manipulation of the after-products, the sirup eliminated in the centrifugal machine, and which is known by the name of "green sirup" and constitutes from 30 to 32 per cent. of the mass produced in the vacuum boiler. In order to crystallize the sugar contained in this green matter, a further boiling is required. First of all, the green sirup, as it runs from the centrifugals, is pumped into certain reservoirs, and after passing through foreheaters, arrives in a vacuum boiler, or sirup-boiler, as it is sometimes called.

In this case, as with all subsequent decoctions of sirup, clear-boiling can alone be effected, the impurity of the sirup being so great that direct crystallization is impossible. The sirup-boiler closely resembles the vacuum boiler (in some cases is identical with it) and is provided with a system of warming-tubes. The steam produced by the boiling of the sirup passes over to the receiver already referred to, and subsequently into the condenser in company with the steam and vapor from the evaporating apparatus and vacuum boiler previously used, and is there condensed to water to be used as waste-water. The sirup-boiler is heated either with spent steam from the steam engine or with vapor

from the evaporating vessels. The sirup contained in it, and which shows 73 per cent. of sugar by the saccharometer, is condensed to about 90 per cent. This apparatus has also to be connected with an air-pump, which operates, together with the other air-pumps previously mentioned, on the common condenser.

The best arrangement, however, is to provide the evaporating station with a special air-pump, and the sirup-boiler and vacuum boiler with one in common. The green sirup is boiled from day to day, and the mass obtained from it by evaporation, and which shows 90 per cent. of sugar by the saccharometer, is called the "second product." This clear-boiled mass is then transferred from the sirup-boiler into receptacles, called reserve receptacles (*v*), and placed in a warm room. Here it remains for about ten days in order to crystallize out. When the crystallization is complete the product is raised in an elevator and placed in tip-trucks, which convey it to a mash machine (W), which is provided with a smasher. The object of the mash machine and the smasher is to pound the larger crystals small. The second product is then conveyed by means of a suspension line (Q), or a transport-worm to the centrifugal machines (X) specially constructed for it.

These centrifugals are built on the same plan as those used in the manufacture of the first product, but their drum diameter is, as a rule, somewhat smaller. The mass placed in these centrifugals is treated in exactly the same way as in the former case; the raw sugar remains behind in the drum and the fluid which runs out is pumped up into the afterproduct chamber. The raw sugar thus obtained is called raw sugar of the second product, and is only distinguished from raw sugar of the first product by a less robust grain. About 25 per cent. of sugar is contained in the green sirup, which is called sirup of the second product. Having left the centrifugals, this sugar goes through exactly the same process as its predecessor, the sugar of the first product. The mass separated out from this sugar in the centrifugals contains about 75 per cent. of nonsaccharine matter. It is drawn up by means of a pump into the reserve receptacles (*v*), and afterwards decocted once more. The separated sirup is transferred from the reserves into the sirup-boiler (exactly as before), and there concentrated from 73 to 90 per cent., the resulting mass being called "third product." This mass is brought into reserve (*v*) in the afterproduct chamber, where it remains for about thirty days, in order to crystallize out. After this crystallization it goes through exactly the same process as in the previous case, raw sugar being finally obtained, which is called raw sugar of the third product. Of this raw sugar, the third-product mass contains about 16 to 18 per cent. This raw sugar is brought into the market in the same way as its two predecessors.

The sirup separated out by the centrifugals (about 82 to 84 per cent. of the entire mass) is also in this case pumped into reserve receptacles in the afterproduct chamber and afterwards sold as molasses (if this

has not already taken place with the sirup of the second product), or it is decocted a fourth time (in the same way as in the previous cases) and the sirup finally remaining over from this last operations old as molasses.

The mass of the fourth product produced from this sirup in the sirup-boiler must remain in the afterproduct chamber for some months, as a rule, until the next *campagne*, at a temperature of 50° C., to render the separation of the sugar of the fourth product a feasible task.

As we have mentioned molasses, we may as well consider this product a little more closely for a moment. Molasses is the last sirup formed in the manufacture of sugar, and on account of its high percentage of nonsaccharine matter can form few or no sugar crystals even after lengthy stocking. It is therefore sold to spirit-distillers or, if the local conditions are favorable, once more manipulated for the extraction of the little sugar which it contains. By employing a sugar-eliminating process (the Steffen separating process is the simplest and best), almost all the sugar contained in the molasses may be obtained. We must refrain from describing this process, for the American patent of the same has been secured for the United States by Mr. Claus Spreckels, of San Francisco, and the process, therefore, can only be employed by that gentleman.

In conclusion we may remark that all the individual machines employed in the sugar branch are constructed in as many different ways as there are machine-factories to make them. Of course these variations are only of an unimportant character, but at the same time we must take this opportunity of recommending specially one firm which concerns itself solely with the construction of all kinds of machinery and apparatus for employment in all branches of sugar-manufacture, whether from beets or cane. The name of this firm is the Maschinenfabrik Langen und Hundhausen, in Grevenbroich (Rhenish Prussia). Its manufactures have always found fullest approval in the sugar-factories where they have been employed. Most of those practical and simply constructed separating apparatus on the Steffen system employed in the manufacture of raw sugar are obtained from this firm.

JOSEPH FALKENBACH,
Consul.

UNITED STATES CONSULATE,
Barmen, November 24, 1888.

Estimated cost of a beet-sugar factory consuming daily (24 hours) 300,000 kilograms of beets, by Messrs. Langen & Hundhausen, in Grevenbroich, Rhenish Prussia.

Number.	Machinery.	Estimated weight.	Estimated cost.
	Beet-house.	*Kilograms.*	*Marks.*
1	One spiral beet-conveyer, 1,000 centimetres diameter and 8,000 centimetres long, with wheel work, propelling power, and grappling-irons, complete	8,000	.....
2	One beet-washing machine, 1,400 diameter, 3,000 centimetres long, stone-catching apparatus, propelling power, and bedding, complete	6,000	.....
3	The iron pieces for a beet-elevator, 12 meters long, with iron trestle-work, tried chains, and funnels, complete	25,000	13,900
	Diffusion and boiling-house.		
4	One beet-cutting machine, with receiving and throwing-out hoppers, gearing, steel spindle, mounted knife-disk (without blades), 3 lifting cars to be inserted on top, complete	.....	.....
5	Twenty-four lifting bars, mounted with receiver, exclusive of blades (reserve)	.....	.....
6	The diffusion battery, consisting of 12 wrought-iron vessels, 1,400 centimeters, 2,100 holes in straight plates, with connecting wrought-iron adjustage, upper and lower manhole cover, bucket-charger, and sieve bottom, complete	.....	.....
7	Twelve single calorisators of 4 square metres heating surface in drawn brass pipes, inclusive of stop-valve, 25 centimeters diameter, escape-valve, 20 centimetres diameter, with thermometer, complete	.....	.....
8	Thirty-six diffusion-valves of 125 centimeters diameter, with rising spindle	.....	.....
9	Twelve tapping-valves, 100 diameter, with wrought-iron lengthening spindles, cast-iron column, with lever	.....	.....
10	Twelve valves, 50 diameter, for air transmission	.....	.....
11	Twelve air-discharging cocks, with curves, 25 diameter	.....	.....
12	Complete pipe system of diffusion battery for juice, water, steam, and air; the diameters worked and bored corresponding to the valves at Nos. 8, 9, 10, and 11	.....	.....
13	Impermeable rubber and screwing apparatus for the pipe system, valves, and man-hole covers of the diffusion battery	.....	.....
14	Three hose cocks, 30 diameter, for water	.....	.....
15	The worked I iron supporters for the diffusion battery	.....	.....
16	One complete chip-filling transporter with wooden gearing, without girders	.....	.....
17	The iron pieces for a horizontal chip transporter below the diffusion apparatus, without girders	.....	.....
18	One horizontal working-machine, 400 diameter, 700 strokes, with Dr. Proll's regulator, Mayer's expansion, with grappling-irons, complete	.....	.....
19	One horizontal steam-pump for carbonic acid, with two air compressors attached, to serve the diffusion and sulphur furnaces; steam-cylinder, 400 diameter; carbonic acid cylinder. 700 diameter; air compressor for diffusion, 200 diameter; sulphur furnaces, 120 diameter; piston for joint use, 700 millimetres	.....	.....
20	Eleven saturation vessels for first, second, and third saturation, of 2,600, 2,200, and 1,200 (broad), inclusive of lime-measuring vessels, armature, and transmission	.....	.....
21	Three stone catchers between saturation and lye-pump	.....	.....
22	One horizontal triplicate lye-pump for the three saturations; steam-cylinder, 425 diameter; plunger, 200 diameter; joint piston, 400 millimeters	.....	.....
23	Seven filter presses, with thirty chambers each, for the first and second saturations, and two filter presses, with twenty-four chambers each, for the third saturation	.....	.....
24	Two sulphur furnaces, with charging pans, compression stop-valves, and air transmission, complete	.....	.....
25	One triple-effect evaporation apparatus, Wellner-Felinck system; I body, 200 square metres; II body, 200 square metres; III body, 200 square metres; total, 600 square metres heating surface; complete, including armature, evaporating liquor conduit of pipes, and three reservoirs for the condensed steam, with armature	.....	.....
26	Horizontal steam-pump machines, consisting of cold-water pump, with sideways attached; pumps for condensed steam, thin juice, sirup and edulcoration; water pump, with air-pump behind; steam-cylinder, 550 centimetres diameter; cold-water pump, 350 diameter, double acting; condensed steam-pump, 175 diameter, double acting; thin-juice pump, 175 diameter, double acting; sirup-pump, 175 diameter, double acting; edulcoration water-pump, 150 diameter, double acting; air-pump, 850 diameter, double acting; engine for joint use, 700 millimetres, complete, with grappling-irons	.....	.....
27	One feed heater for condensed steam from evaporated juice, 150 square metres heating surface, in drawn brass pipes, counter construction, complete, with armature (vertical); one feed heater for direct steam of the same construction, 45 square metres heating surface, complete	.....	.....
28	One vacuum, Wellner-Felinck system, holding 15,000 kilograms feeding fluid, of 70 square metres heating surface, constructed for direct and reverse steam, complete, with armature	.....	.....

Estimated cost of a beet-sugar factory, etc.—Continued.

Number.	Machinery.	Estimated weight.	Estimated cost.
	Diffusion and boiling-house—Continued.	*Kilograms.*	*Marks.*
29	One sirup vacuum, with vertical pipes of 60 square metres heating surface, complete, with armature, for direct and reverse steam	.....	.....
30	Two horizontal cooling mash-basins, with elliptical stirring apparatus, to hold 10,000 kilograms of fluid, with water-cooler, gearing, etc., complete	.....	.....
31	One wrought-iron cataract condenser, with recondensation, 13,000 diameter, 2,200 centimetres high. Total of Nos. 4 to 31, inclusive	.....	188,278
	Sugar-house.		
32	Six armor-plated centrifugal machines, with tambour, 960 diameter, 470 millimetres high, with wrought-iron jacket reaching to the ground, complete	.....	.....
33	One feeding carriage, with sliding stop-valve, and suspension track above the centrifugal	.....	.....
34	One plunger pump, for transmission, of 100 diameter, 150 strokes	.....	.....
35	One horizontal machine, 350 diameter, 700 strokes, with Dr. Pröll's regulator and Mayer's expansion, complete, with grappling-irons	.....	.....
36	One horizontal mash for by-products, with a crushing machine, 500 diameter, 1,200 centimetres long	.....	.....
37	Ten crystallization vessels of sheet-iron, with sliding stop, of 10 square metres volume each for first produce; twenty-five crystallization vessels, of 18 square metres volume each, for second produce	.....	.....
38	The iron pieces for two complete cable elevators, with English chains, etc. Total of 32 to 38, inclusive	.....	40,650
	Lime station.		
39	The iron pieces for a limekiln, with three coke furnaces, complete, with wrought-iron casing	.....	.....
40	The iron pieces for a limestone elevator, with stool, English chains, etc., without wooden gearing	.....	.....
41	One wrought-iron laver for cooling and washing the carbonic acid, with sieve, bottom, man-hole cover, etc., complete	.....	.....
42	Three wrought-iron, lime-slacking vessels, with stone catcher, delivery valve, etc	.....	.....
43	One wrought-iron lime-milk settling vessel, No. 3	.....	.....
44	Lime-milk stirring apparatus in wrought-iron box, with bedding, gearing, etc	.....	.....
45	One plunger-pump to carry the lime-milk to the saturation, 120 diameter, 180 strokes. Total of 39 to 45, inclusive	.....	7,360
	Boiler house.		
46	Seven steam-boilers of 90 square metres heating surface, with the necessary armature, according to the legal requirements of the German Government	.....	.....
47	One horizontal steam feed-pump, with governors; steam-cylinder, 300 diameter; pump cylinder, 200 diameter; strokes, 400 millimetres; complete, with grappling-irons; one hand-feed pump, 80 diameter, 200 strokes	.....	.....
48	One feed-water reservoir of wrought iron, 1,400 diameter, 3,000 centimetres long, with safety-valve, water mark, etc	.....	.....
49	Transmission for the whole factory works. Total of 46 to 49, inclusive	.....	72,275
	Grand total (at 23.8, $76, 746)	.....	322,463

AUSTRIA-HUNGARY.

AUSTRIA-HUNGARY, 1867.

REPORT BY CONSUL-GENERAL POST, OF VIENNA.

The production and the export of beet-root sugar is increasing, and the history of its increase is best shown by the following table:

Table showing the quantity of beets taxed and used during the last three years in Austria.

Season of—	No. of factories in operation.	Quantity of beets taxed.	Amount of tax collected.	Average quantity of beets used by one factory in the three years.	Average amount of taxes paid by one factory during the three years.*
		Vienna cwt.	*Florins.*	*Vienna cwt.*	*Fl. kr.*
1864–'65	143	18, 040, 561	7, 387, 609	125. 916	51, 562 60
1865–'66	138	15, 612, 209	6, 393, 199		
1866–'67	138	19, 105, 874	7, 823, 855		

* The tax on beets is at the rate of 40.95 kreutzers per Vienna centner. A Vienna hundred-weight is equal to 123.4616 pounds.

Table showing Austria's sugar production, consumption, export and import, during the las thirty-three years, from 1834–'35 *to* 1867.

For the season of—	Average quantity of beets taxed per year.*	Amount of raw sugar produced per year.*	Average import of colonial sugar per year.*	Sugar exported per year.*	Colonial sugar imported and beet-root sugar productions, less the exportation per year.*	Population.	Amount of sugar consumed per person.†	Average price of loaf sugar.	No. of factories in operation.
1834–1839	605, 616	30, 270	518, 193	38	548, 425	36, 000, 000	1. 52	44. 25	37. 2
1839–1844	1, 577, 995	78, 875	574, 470	89	504, 316	35, 444, 400	1. 42	38. 00	42. 6
1844–1849	1, 729, 280	103, 757	568, 955	150	672, 562	37, 160, 400	1. 81	38. 00	59. 4
1849–1854	5, 196, 896	311, 814	787, 478	324	1, 098, 968	36, 451, 600	3. 01	39. 20	97. 6
1854–1859	11, 712, 692	820, 080	581, 489	88	1, 401, 481	36, 714, 600	3. 00	41. 90	119. 2
1859–1864	17, 798, 429	1, 246, 090	71, 125	21, 058	1, 296, 157	36, 917, 200	3. 51	39. 50	135. 2
1864–1867	19, 201, 861	1, 344, 136	2, 115	506, 074	840, 177	35, 650, 000	2. 36	30. 32	139. 4

* Custom cwt. † Custom pound.

P. SIDNEY POST,
Consul.

UNITED STATES CONSULATE-GENERAL,
Vienna, December 31, 1867.

AUSTRIA-HUNGARY—1870.

REPORT BY CONSUL-GENERAL POST, OF VIENNA.

The production of beet-root sugar in the Austro-Hungarian monarchy has been as follows:

	Vienna centners.	Florins.
1868	20, 030, 937	8, 202, 668
1869	21, 982, 209	9, 001, 713
Increase	1, 951, 272	799, 045

Shortly after the opening of the sugar campaign in 1868 and 1869, alarming reports were spread abroad concerning the quantity of beets, indicating that there were insufficient supplies even for home consumption. Unfortunately no official and trustworthy contradiction was made of these reports, though, in consequence of the tax levied upon the beets, it would have been easy to have given such official denial. In the month of January a combination was formed, and the price advanced more than 10 per cent., but it soon became evident that the old beet crop had been underestimated, and the old prices were again restored.

ROBERTS'S NEW INVENTION.

A former report, published in the Commercial Relations of the year 1867, page 513, contained a description of Roberts's diffusion process for extracting sugar from cane or beets. That invention required what was called a "battery of diffusion," consisting of a number of vessels which were filled with a certain quantity of the sliced cane or beets, and through which water, heated to a certain temperature, was forced in a certain succession and systematic order requisite for the complete extraction and proper concentration of the diffusion juice.

Mr. Roberts has now perfected this invention, or rather made a new invention, and this diffusion process may now be carried on in a single vessel through the instrumentality of a feeding apparatus, by means of which the slices of cane, beet root, or other plant from which the sugar is to be extracted are introduced at the bottom of the vessel, and in which they slowly and gradually rise to the top, while fresh water isconstantly running in at the top of the diffusion vessel, and after having remained in contact with the slices for a sufficient length of time, and having extracted the sugar therefrom, it is drawn off as diffusion juice at the bottom. The water in its gradual descent through the entire length of the diffusion vessel passes through all the stages of gradual increasing concentration which are obtained in the diffusion vessels of a diffusion battery, and the slices in their ascent become gradually extracted in a corresponding manner, so that the whole process of extraction is effectively carried out in one single vessel. Mr. Roberts has tried his invention at his sugar factory on a large scale, and has found it to work to his entire satisfaction.

P. S. POST,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Vienna, September 30, 1870.

AUSTRIA—1873.

REPORT BY CONSUL-GENERAL POST, OF VIENNA.

The remarkable invention of Julius Roberts for extracting sugar, described in former reports published in the Commercial Relations, 1867 and 1870, has proved itself to be a most useful and important one. The diffusion process is applicable to extracting sugar from cane as well as from beets, and a large amount of machinery is now on the way from this Empire to Louisiana, for the introduction of the process in our sugar-producing districts. The favorable reception this diffusion process has received in the beet-root manufacturing countries is best indicated by the following table, which shows its rapid and general introduction:

Table showing the nnmber of manufactories which have adopted the Roberts diffuston process.

Year.	Austria.	Germany.	Russia and Poland.	Holland.	Sweden.	Denmark.	East Indies.	New.	Remodeled.	Total.
1865	1	.....	1	.....	.....	.....	.....	1	1	2
1866	3	5	.....	.....	.....	.....	1	3	6	9
1867	10	2	3	.....	.....	.....	.....	9	6	15
1868	13	2	3	1	.....	.....	.....	11	8	19
1869	14	15	4	1	2	.....	.....	24	12	36
1870	27	23	6	.....	1	.....	.....	45	12	57
1871	37	11	6	.....	.....	.....	.....	39	15	54
1872	24	6	9	.....	1	1	.....	18	23	41
1873	.....	.....	10	.....	.....	.....	.....	8	2	10
	129	64	42	2	4	1	1	158	85	243

P. S. POST,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Vienna, September 30, 1873.

AUSTRIA-HUNGARY—1885.

REPORT OF VICE-CONSUL HÜNING, OF PRAGUE.

A direct shipment of beet-root sugar was made a few weeks ago from this consular district to the United States, the first one of this kind. As this industry is of the greatest interest to America, I applied to the chamber of commerce, to the board of trade, and to other official sources for information on this subject, the result of which I submit herewith.

There are few countries in Europe of the same extent and population for which the beet-root sugar industry has equal importance and significance as Bohemia, not alone on account of the prominent position which this branch of industry occupies, but also on account of its bearing on the rational cultivation of agricultural lands, the breeding of

cattle, the adoption of machinery, and the opening of new communications. Statistics show that the prosperity and decline of the Bohemian sugar industry affects to a greater or less extent the banking institutes, the coal-mining interest, and the spirit manufactories. The Bohemian sugar industry is greater than that of all the other provinces of the Empire, Hungary included, taken together.

Official statistics show that during the campaign of 1883–'84 the entire number of sugar factories in Austria-Hungary was 230, of which 152 were located in Bohemia; and that of the entire quantity of 41,845,679 metrical centners of beets on which a tax was levied before they were manufactured into sugar, 26,178,845 metrical centners fell to the share of Bohemia alone.

The following table shows the quantity of beets converted into sugar, the Government tax levied, and the number of factories in Bohemia during the last ten years:

Year.	Number of factories.	Quantity of beets.	Amount of tax.	Average amount of each factory.	
				Quantity.	Tax.
		Met. cent.	*Florins.*	*Met. cent.*	*Florins.*
1874–'75	145	5, 344, 100	3, 907, 434	36, 856	26, 948
1875–'76	150	8, 581, 660	6, 263, 352	57, 211	41, 756
1876–'77	149	9, 725, 560	7, 099, 654	65, 272	47, 649
1877–'78	152	15 297, 910	11, 167, 474	100, 644	73, 470
1878–'79	151	17, 619, 500	12, 862, 230	116, 685	85, 180
1879–'80	150	18, 266, 150	13, 334, 227	121, 774	88, 895
1880–'81	152	28, 081, 510	22, 465, 210	184, 747	147, 797
1881–'82	155	28, 327, 110	22, 661, 685	182, 756	146, 234
1882–'83	154	31, 968, 280	25, 574, 626	207, 586	166, 069
1883–'84	152	26, 178, 845	20, 943, 076	172, 229	137, 783
Average	151	18, 939, 062	14, 627, 897	125, 424	96, 873

Exports of sugar from Bohemia on which the Government bounty was paid.

[In metrical centners.]

Year.	Refined.	Powdered.	Total.
1875	38, 695	446, 981	485, 676
1876	114, 387	763, 365	877, 752
1877	99, 979	850, 669	950, 648
1878	120, 892	745, 154	866, 046
1879	136, 448	1, 219, 751	1, 356, 199
1880	167, 775	1, 481, 559	1, 649, 334
1881	269, 897	1, 589, 370	1, 859, 268
1882	316, 095	1, 101, 564	1, 417, 659
1883	464, 930	1, 257, 373	1, 722, 303
1884	467, 564	1, 552, 534	2, 020, 098
Average	219, 666	1, 100, 832	1, 320, 498

The bounty paid by Government in 1884 for sugar exported from the countries represented in the Reichsrath amounted to 23,313,468 florins, for sugar exported from Hungary to 1,011,877 florins, and from Bohemia alone to 19,977,076 florins, of which sum 5,400,372 florins was for refined and 14,576,734 florins for powdered sugar, while in 1883 the

amount paid for bounties for exports from Bohemia was 17,184,482 florins.

During the campaign 1884–'85 there were in operation in the entire Austrian Empire 249 sugar factories, of which number 165 were situated in Bohemia. Of these latter 50 were owned by joint stock companies, 3 by large corporations, 2 by the Bohemian Sugar Industrial Society, 60 by the nobility, 3 by the Emperor, and the rest by private parties.

Machinery employed by the sugar factories of Bohemia and of Austria-Hungary during the campaign 1883 *to* 1884.

Items.	Bohemia.	Entire Empire.
Total number of factories	152	230
Total number of steam-boilers	1, 223	1, 912
Heating surface in square metres	91, 343	157, 273
Motive power:		
Steam horse-power	16, 334	25, 809
Water	26	31

Quantity of beets converted into sugar, and the expenses of manufacture and fuel, during the campaign 1883 *to* 1884.

Items.	Bohemia.		Entire Empire.	
	Quantity.	Average price per metrical centner.	Quantity.	Average price per metrical centner.
	Met. cent.	*Kreuzers.*	*Met. cent.*	*Kreuzers.*
Fresh beets used	26, 178, 169	100–200	41, 845, 679	95–200
Manufactured sugar	619, 964	.....	765, 844	.....
Molasses	1, 336, 840	.....	1, 383, 880	.....
Fuel:				
Coal	12, 195, 702	80–190	17, 831, 151	28–130
Charcoal	295	190–400	295	190–400
Cokes	87, 414	120–175	118, 444	103–175
Wood	155	360–500	18, 125	200–500
Spodumene	229, 609	72–20	365, 897	11–20

During the campaign of 1883–'84 the number of persons employed in the sugar manufactories of Bohemia was 30,580 males and 11,332 females, and in those of the entire Empire of Austria-Hungary 46,683 males and 20,024 females, whose daily wages average from 35 kreuzers to 1 florin; 80 kreuzers per day for males, and from 20 kreuzers to 1 florin 20 kreuzers for females.

The Government tax on beets for the same period of time amounted to 20,942,535 florins for Bohemia and to 33,476,543 florins for the entire Empire.

The extraction of the juice in the 152 factories of Bohemia took place by means of what is known as the diffusion process, while the old method of employing grinding and powerful presses was adopted by twelve factories situated in other parts of the Empire.

When sugar first became an article of export the Government paid a certain bounty or drawback, which in 1860 was 5.16 florins on the centner of refined and 4.20 florins on powdered sugar. In 1864 the bounty was increased to 6.51 florins on refined and 5.30 florins on powdered

sugar, and the bounty paid at present is 8.40 florins on the metrical centner of sugar containing from 88 to 92 per cent. of saccharine matter; 9.40 florins on the metrical centner of sugar containing from 92 to 99½ per cent. of saccharine matter, and 11.55 florins on the metrical centner containing more than 99½ per cent.

The financial calamities caused by the crisis in the sugar trade in the fall of 1884, the unforeseen collapse of the Bohemian "Boden-Credit-Anstalt," which caused the closing of a number of sugar factories depending entirely upon that institution for support, and the consequent lack of faith on the part of the Bohemian and Moravian growers, rendered a further existence of this branch of industry for some time extremely doubtful. A long time was required before matters became more settled and confidence restored, and even now it has not yet entirely recovered. It is now admitted on all sides that the crisis was caused by an excessive cultivation of beets and an irrational overproduction of sugar in Bohemia and other sugar-producing countries of Europe, and that the gradual improvement is due solely to the movement in favor of a reduced cultivation of the sugar beet.

The prospect, however, that the Bohemian sugar industry will fully recover from the disastrous blow it had been made to feel, is made problematical by the fact that this branch of its industry is confined almost to export alone, and that foreign legislation, repeated increases in the rates of tariffs and customs, as well as obstacles in the means of communication and transportation, all tend towards driving the Bohemian sugar from foreign markets without opening new fields, and home consumption being as yet far too little developed in proportion to the number of population to make it remunerative, the more so as the frugality of the people is proverbial and not likely to undergo a sudden change.

The consumption of sugar in Austria is calculated to average 6 kilograms for every inhabitant per year, but in Bohemia, where coffee is in great demand, it is a fraction over 6 kilograms.

From the following statement, compiled from official statistics furnished me for this purpose, may be learned the actual present condition of the beet-root sugar industry of Bohemia and of Austria-Hungary during the campaign of 1885–'86:

Items.	Bohemia.	Entire enterprises.
Factories in operation	139	214
Factories closed*	11	14
Refineries in operation	11	15
Refineries closed	2	3
Extraction of juice by diffusion	139	203
Extraction of juice by pressure	.....	11
Exclusively powdered sugar	107	144
Refined and powdered	18	35
Exclusively refined sugar	22	44
Exclusively pilé	3	6
Molasses	150	229

* There are six factories aside from these where resumption of business is doubtful, but likely they will remain closed.

Table showing the average price of the metrical centner of sugar in Austrian currency (florins) and the London rate of exchange, during the ten years from 1876 *to* 1885.

Description, etc.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
Powdered sugar, basis 88 per cent., at Bohemian railroad station	28.05	45.12	31.43	29.90	36.00	33.92	33.60	30.65	28.77	19.42
1*a*. Centrifugal pilé, free transit, Trieste	30.25	44.50	32.00	30.00	33.37	31.00	32.00	29.25	27.25	17.25
Fine brod molasses, from Vienna railroad station	43.00	61.50	44.50	42.50	47.12	42.50	46.00	43.12	41.00	30.87
London rate of exchange	113.06	125.53	120.12	117.20	116.92	117.74	118.93	119.44	121.06	123.40

TOTAL AVERAGE DURING THE TEN YEARS.

Powdered sugar, basis 88 per cent., at Bohemian railway station	31.64
1*a*. Centrifugal pilé, free transit, Trieste	30.68
Fine brod molasses, from Vienna railway station	44.29
London rate of exchange	119.31

The greater part of the sugar exported from Bohemia is sent by way of the river Elbe to Hamburg, and from there to England.

Other markets are Holland and France, though legislation in these two last-mentioned countries has seriously injured the trade of late; the export to Italy has also suffered in consequence of the higher rates of duty imposed, the gradual development of domestic production, and the competition made by Russia. The chief markets for Bohemian sugar are the Balkan States, Servia, Roumania, Bulgaria, and Greece, Turkey, and the Levant, where it not only occupies the first position, but has even succeeded in driving its rivals and competitors, England and France, almost entirely from these markets, and it is only quite recently that Russia begins to boom up as a competing power. Some shipments even found their way to Persia, to ports of the Red Sea, and to Ceylon, as well as to Tunis and Morocco. Several attempts have been made to gain a foothold in the markets of the West, and several shipments were made to Spain, to the La Plata States, and other South American countries, and one to the United States, but there is not the slightest doubt that a great deal of the "German sugar" shipped from Hamburg to the United States is Bohemian product; and as soon as the investigations I am now making to find out this proportion have placed me in possession of the necessary information, I shall immediately place it at your disposition.

WILLIAM HÜNING,
Vice-Consul.

UNITED STATES CONSULATE,
Prague, Bohemia, February 6, 1886.

AUSTRIA-HUNGARY--1889.

THE SUGAR-BEET INDUSTRY OF BOHEMIA.

REPORT BY COMMERCIAL AGENT HAWES, OF REICHENBERG.

INTRODUCTORY.

During the year ended June 30, 1888, the United States imported sugar, including molasses and confectionery, amounting to $79,760,891. So little sugar is grown in the United States, indeed, that it has been proposed to remove the duty on this article upon the ground that we have no sugar industry to protect.

The Department of Agriculture has for years, with the aid of Congress, been endeavoring to establish a substitute for sugar cane by the cultivation of sorghum. While the latter experiments seem to show that sorghum can be successfully cultivated and manufactured into sugar in the United States, I desire to call attention to a subject that has passed beyond the stage of experimentation in Europe, and which, indeed, meets the indorsement of so practical and successful a manufacturer as the well-known Claus Spreckels. According to this authority, sugar-beet culture can be successful and profitable just as much on the Atlantic slope as on the Pacific, in the Mississippi Valley as in California.

Why should we pay out $80,000,000 yearly for an article that we can easily produce ourselves?

Clearly our efforts should be directed to the development and protection of such an industry until we may be able to save the enormous sum now paid to foreign countries, if not eventually to supply those countries themselves with sugar.

It has been my aim to make the following report so complete that the practical farmer, as well as the theorist, may become interested in the subject and find all the details necessary for his information. I have also described briefly the process of manufacture.

With this preface I will pass directly to my subject, and first call attention to the

CULTIVATION OF THE SUGAR BEET.

The sugar beet (*Beta vulgaris saccharifera*) is a variety of the class *Beta vulgaris linnæi*, and belongs to the family *Chenopodiaceæ*. It has become biennial by cultivation, and there are many varieties.

The conditions required of a good sugar beet are—

(1) Regular shape (cone, pear, or olive shape). Many side roots or prongs are disadvantageous, because they make cleaning more difficult and increase the waste. The leaves should be thick and should be of the characteristic shape and color, and those which lie flat are to be preferred as protecting the beet against frost.

(2) A medium size, say, 1 to 2 pounds. Small beets make a small

crop, while large beets contain comparatively little sugar. The length should not be more than 35 centimeters. The crop should not be less than 30,000 kilograms to the hectare ($2\frac{1}{5}$ acres).

(3) Rich in sugar—from 9 to 16 per cent.

(4) A white, compact, brittle substance. Such beets are more resistant to destruction by storage. A small head not protruding from the ground, as this head must be cut off, containing, as it does, very little sugar.

It is very important to select the proper variety for a given district, because the different economical conditions of climate and soil require different varieties, if the largest possible crop is to be harvested. It is, therefore, quite necessary for every farmer to experiment with different varieties.

VARIETIES OF BEET.

The varieties which fulfill the above conditions are—

(1) *The white beet of Silesia.*—This beet was formerly the best sugar-beet; to-day it is only used where large quantities are required, as it does not contain as much sugar as some other varieties. This beet requires an excellent soil.

(2) *The Quedlinburger.*—This beet is distinguished as ripening 14 days earlier than most other beets, so that in localities where an early frost is the rule this beet is to be preferred.

(3) *The Imperial.*—This beet is excellent for deep, good soils. It has now three offspring:

(*a*) The white Imperial, by Knauer.

(*b*) The small Wanzlebner, which has a high percentage of sugar.

(*c*) Brothers Dippe small Wanzlebner.

(4) *Knauer Electoral.*—This is good on soils otherwise unfit for beet cultivation, as hilly lands and poor alluvial soils.

(5) *Knauer Mangold.*—This beet at present contains the highest percentage of sugar.

(6) *Vilmorin.*—This beet is very valuable, as it produces a sufficient percentage of sugar on low lands rich in nitrogen, and in soils where all other kinds are valueless.

The offspring of this variety are—

(*a*) Vilmorin blanche ameliorée.

(*b*) Vilmorin rose partial.

(*c*) Vilmorin blanche collet rose.

(*d*) Vilmorin collet verte race braberut.

(*e*) Brothers Dippe white élite—very rich in sugar.

(*f*) Besteborn's Imperator, which is not recommended, as it has the faults of the Vilmorin, *i. e.*, too many side rootlets and not sufficient sugar.

CLIMATE.

In Europe the sugar beet is successfully planted between the forty-seventh and fifty-fourth degrees of northern latitude; in Germany, between the fifty-first and fifty-fourth; in France, between the forty-seventh and fiftieth; in Austria-Hungary, between the forty-eighth and fiftieth; and in Russia, between the forty-eighth and fifty-third degrees.

Like all plants, the sugar beet requires certain conditions of climate to arrive at perfection.

According to the experiments of Briem, director of the experimental station in Grusbach, Moravia, concerning the distribution of warmth and rainfall during the period of vegetation of the sugar beet in the first period, *i. e.*, in the first two months, the time of germinating, the daily temperature was 10.70° C.; in the second period (the time of development of the vegetative organs), 18.8° C.; and in the third period (in which the storage of the reserve substances takes place), 16.5° C.; and during the whole vegetation, 15.3° C.

The total warmth in the first period was 650° C.; in the second, 1,150° C.; and in the third, 1,000° C.

The rainfall was in the first period 97 millimetres; in the second, 114 millimetres; and, in the third, 100 millimetres; together, 311 millimetres. The sugar beet needs much warmth and light, sunny days, and a certain amount of moisture.

The best climate for sugar beets is the so-called "wine climate," with a temperature from 9° to 10° C. in April and May, 17° to 18° C. in June and July, and 15° and 12° in August and September, respectively.

The seacoast is not warm enough and has not enough sunny days in June and July to be successful for sugar-beet raising.

For the first period of vegetation it is necessary that a certain amount of winter moisture be in the ground, as the seeds need moisture to germinate. In the second period warmth and moisture are required for the production of roots and leaves. In the third period, in which the saccharification goes on, dry warmth. If the days be sunny, the beets will become rich in sugar; but if this period be wet the crop will be great in quantity, but poor in quality. If, after a dry summer, a warm and rainy fall follows, new leaves spring up at the cost of the sugar.

SOIL.

The best soils for quality as well as quantity of production, according to the experiments of Orth, are those that consist of mild, moist loam about 50 centimetres deep, then loam or marl 1 to 2 metres, and, under this, sand. Such soils, which are easy to cultivate, have a high degree of absorption, can combine nourishments, and give the plant physically a good start. Such soils are called "natural sugar-beet soils."

It is possible to raise beets on soils that do not have all these qualities, but the crop will be better the nearer this standard is approached.

The conditions required for a good sugar-beet soil are—

(1) Depth, because the roots mostly take their nourishment from a depth of 30 centimetres, and the soil must therefore be loosened and contain nourishment up to this depth.

(2) Porousness of the subsoil, because it is impossible to cultivate a damp, cold soil at the right time. Such a soil will become cracked if very dry, and the young plants suffer, while the beets will contain little sugar. In such a case drainage must be employed. Clay soils can be improved by manuring, by the use of lime, and drainage; light soils, by manuring and loamy marl.

Leplay found that the heaviest beets will be raised in descendant succession from clay, lime, loam, and sand soils; beets with the greatest percentage of sugar, in lime, clay, sand, and loam soils; the most leaves, in sand, clay, lime, and loam soils. According to experiments of Marek, the more moisture in the soil the greater will be the development of leaves. This influence is stronger in sand soil than in one of clay. The normal development of the root depends upon organic matter in the soil. The more moisture there is in the soil the looser the texture, the poorer the quality, and the less sugar will be in the beet.

The following soils are adapted for the culture of the beet, if they have a good subsoil: Loamy soils, mild, clayey, or sandy, and clay marl. Of clay soils, the mild and loamy ones; if the amount of clay is excessive the soil must be made suitable by manuring. Strong clay soils are useless for beets, but clay-marl soils are good. Sandy soils are least adapted to the cultivation of the sugar beet, with the exception of loamy sand soil not deficient in humidity and the subsoil possessing enough water-holding power. Lime soils are, with the exception of loamy lime soil, not good for beets. From moist soils are raised good quantities, but poor qualities.

The best locations for sugar-beet-planting are on level or only slightly sloping lands, because work is done best on such lands and it is impossible for the beets to be swept away by heavy rains.

TRANSPORTATION, MARKET, AND LABOR.

Sugar beets are, in relation to their weight, cheap, and therefore it is not possible to transport them great distances. They should, therefore, be planted not far from the factory or the railway. The calculations of Settegast (Germany) show the influence of transportation upon beet-raising. His results show that, if 50 kilograms (112.5 pounds) of beets cost 25 cents, transportation on country roads costs $3\frac{3}{4}$ cents, and by rail 0.625 cents, for 1 German mile, or 4 English miles, therefore, beets are worth nothing if they must be carried 26.68 miles on a country road or 160 miles by rail.

It is very important to have laborers enough, as it is impossible to do all of the work by machinery. The best way to provide laborers is

to give them work the whole year—in winter in the factory, in summer in the field. One man (German) can do in a day's work of 10 hours and for a day's pay: Sowing by hand after the marker, 0.15 to 0.075 acres; cultivating the young plants, 0.75 to 0.10 acres; hilling up by hand, 0.15 to 0.20 acres; thinning out, 0.10 to 0.125 acres; harvesting and loading, 2,250 pounds. Contract work, one-third to one-fifth more.

MANURING.

The sugar beet, of all the cultivated plants, needs the greatest amount of nourishment in the soil. It is, therefore, very necessary to use such a manure as will supply it with the best nourishment and in such a condition that it can be taken up by the beet. Possibly some soils are rich enough to do without manuring, but this seldom occurs. There are cases where beets have been raised in the same fields for 10 successive years without fertilizer, and yet good crops have been obtained.

The ability of the sugar beet to disclose and take up nourishment is not very high, and, therefore, if a large crop is desired, much manure must be used. Manure must be used that will increase the percentage of sugar as well as the quantity of the crop.

According to E. Wolff, in 1,000 kilograms of sugar beets are—

Constituents.	Roots.	Leaves.
	Kilograms.	*Kilograms.*
Water	815	897
Nitrogen	1.6	3
Ashes	7.1	15.3
Potassium	3.8	7
Sodium	0.6	2
Lime	0.4	3.1
Magnesia	0.6	1.7
Phosphoric acid	0.9	0.7
Sulphuric acid	0.3	0.8
Silicic acid	0.2	1.6
Chlorine	0.3	1.3

If we calculate per hectare (2.5 acres) 30,000 kilograms of beets (67,500 pounds) and 7,000 kilograms (15,750 pounds) of leaves, there is removed from the ground by beets—

Description.	Nitrogen.	Potassium.	Phosphates
	Kilograms.	*Kilograms.*	*Kilograms.*
Roots	48	114	27
Leaves	21	28	5
Total	69	142	32

STABLE MANURE.

The direct application of stable manure to the beet is not good, because the beet will then not ripen at the right time, and the quality will be poor. Stable manure should not be put in the soil in the spring. It should be plowed under in the fall. The manure of sheep is worth-

less, as it contains too much nitrogen and potassium, and the amount of salts in the beets is so increased that they are hardly fit for the factory. Manure of cattle can be used if mixed with that of horses. This manure contains sufficient nourishment, but the amount of nitrogen in proportion to phosphoric acid is too high. This should be 1 to 2, but in this manure it is just the contrary. The amount of manure usually needed per hectare (2.5 acres) is between 20,000 and 40,000 kilograms. According to a table by Wolff there is produced in the ground by applying 30,000 kilograms of manure 150 kilograms nitrogen, 78 kilograms phosphates, and 189 kilograms potassium. From this nourishment the result of applying freshly decomposed manure is, in the first year 35 to 50 per cent.; in the second year, 40 to 35 per cent.; in the third year, 25 to 15 per cent. An average crop of sugar beets (30,000 kilograms) needs 69 kilograms nitrogen, 32 kilograms phosphates, and 142 kilograms potassium. Compost is a very good manure, but it is not good to use any sugar beet soil in its preparation, as it may contain nematodes.

FERTILIZING.

In applying fertilizer, not only the crop but the quality of the beets will be better if it be used alone or employed to modify stable manure. Generally nitrogen, salts, and phosphates are used; exceptionally, potassium. According to P. Wagner the following amount of phosphoric acid and nitrogen should be used:

Description.	Minimum. per hectare.	Mean per hectare.	Maximum per hectare.
	Kilos.	*Kilos.*	*Kilos.*
Dissolved phosphates	40	60	80
Nitrogen	20	30	60

If nitrogen, as Chile nitrate, is used, then there will be needed 150 kilograms minimum, 250 kilograms mean, and 400 kilograms maximum.

TIME FOR MANURING.

Manuring should always be done as early as possible in the fall. The longer the manure has been in the ground before the vegetation of the beet the greater will be the amount of nourishment and its distribution. Experiments show that manuring in spring is wrong, and there are many reasons why. For instance, if the season is dry the manure can not decompose, the ground remains loose, and consequently the young plant suffers for water. On the other hand, as soon as a heavy rain comes after a drought the leaves grow very fast, but the plant does not ripen well, and a large crop is raised, but of a poor quality. If the manure is not decomposed, the work in the field can not be done in good shape, and insects have a good refuge. On heavy, loamy soils fresh manure is good for loosening it and allowing the air to enter.

How deep to put the manure.—It is best first to put the manure in the ground as shallowy as possible, because it decomposes better until the deep plowing is done. The more nitrogen the beet finds in the first period of its vegetation the better. The less nitrogen found in the ground in the first period the more will be taken up in the last period, and that means a loss for saccharification.

The following table shows, by the experiments of Liebscher, that the crop may be increased without losing in quality if the manure be properly applied and the beets planted closely:

Manure per hectare.	Sap.		Crop per hectare.
	Sugar.	Quotient in purity.	
	Per cent.	*Per cent.*	*Kilos.*
None	16.4	89.1	31,065
20,000 kilograms	16.3	87.4	34,785
30,000 kilograms	16.4	88.8	35,435
40,000 kilograms	16.2	89.1	42,100

The more nitrogen there is in the soil the less fertilizer will be required, but the more phosphate.

The increase of the crop by fertilizing with nitrogen is, according to experiments by Wagner, 100 kilograms Chile saltpeter with 15½ to 16 kilograms of nitrogen increases the crop about 4,500 kilograms of beets and 900 kilograms of leaves. Fertilizing with nitrogen should take place only when enough phosphate, lime, and potassium is in the soil, because large and good crops can only be expected when these substances are present. Whether enough phosphate is present can only be learned by experiment. Fertilizing with nitrogen should only be done in the spring. Chile nitrate should always be preferred, and the following rules should be observed:

(1) A good variety must be planted.

(2) Seeds should be obtained from the best sources.

(3) In addition to Chile nitrate, phosphate must be added, or the crop will mature too late.

(4) Fertilizing with Chile nitrate should be done before sowing, not after.

(5) Beets must be thickly planted and cultivated four or five times.

According to the calculations of Stutzer, the use of more than 400 kilograms to the hectare of Chile nitrate does not pay.

Professor Marker has experimented upon the influence of phosphates with the following results:

Phosphates do not always produce an effect. If the soil is supersaturated with it it can cause loss. This has often been observed by practical farmers. The cause is that P_2O_3 quickens maturity or causes an early death of the leaves, and that may lessen the crop, especially in a dry, rainless season.

Ten experiments have given the following results:

Fertilizer.	Crop per hectare.	Increase.
	Kilos.	*Kilos.*
Without phosphate (P_2O_3)	32,063	
400 kilograms precipitate	34,456	2,393
Superphosphate (P_2O_5—76 to 80 kilograms)	35,346	3,283
400 kilograms Thomas slag	33,589	1,526
1,000 kilograms Thomas slag	34,756	2,693

There is not much difference in the effect of the various phosphate fertilizers so far as sugar in the beet is concerned. If it be necessary to use phosphate fertilizer in spring, superphosphate is always to be preferred.

SPREADING THE FERTILIZER.

Spreading broadcast has been found to be better than drilling.

There are, however, drills which have an attachment for drilling fertilizer.

It is very important to put the fertilizer in the right depth. Practical experiments have shown that it should not be used after sowing. In using Chile nitrate a shallow harrowing in sufficient, because the next rain will carry it deeper. Potassium and phosphate, which are absorbed immediately, must be put deep enough so that they will not evaporate. This can be done with a sharp harrow, or, better still, by shallow plowing. It is said that a depth of 20 to 22 centimetres is the best.

The following table shows the results of different depths in sandy loam per hectare:

Year.	Depth.		Difference.	
	10 to 12 centimetres.	20 to 22 centimetres.		
	Kilos.	*Kilos.*	*Kilos.*	*Per cent.*
1881	32,674	38,543	5,869	17.96
1882	36,217	39,030	2,813	7.77
1883	65,726	69,596	3,870	5.89

MIXED FERTILIZER (PHOSPHATE AND NITROGEN).

Of these are used, Peruvian guano (7 per cent. nitrogen to 10 per cent. P_2O_5), ammonia superphosphate, blood manure, with superphos. phate. Bonedust is seldom used, as its effect is too slow; if used, it must be applied in the fall.

Although most soils have potassium enough, it may occur that lands where beets are raised every year may need it. The direct application of potassium salts to the beets is not good, because all these salts contain a chloride which injures the plants. The best is to give potassium mixed with stable manure two years before the beets are planted. When thus mixed the ammonia is kept from becoming volatile.

Lime.—Quicklime is a good fertilizer, especially on very heavy soils, which it loosens. For 1 hectare 24 to 40 kilograms should be used.

For sandy soils marl is excellent, the best containing 30 to 50 per cent of lime. The amount of marl needed for 1 hectare, if containing 30 per cent. of lime, is 220 kilograms; if containing 50 per cent., only 130 kilograms.

PREPARATION OF THE LAND.

The sugar beet needs well cultivated land. First, a surface loose and fine, which allows the air to enter and facilitates germinating and swelling; second, deep, loose, uniform soil, because the beet should develop a slender root without side rootlets. Both can be obtained only by good cultivation. Cultivation differs according to the soil.

The following suggestions are of value: Loosen the subsoil without bringing it to the surface. If the subsoil be not good, this is doubly important. The depth should be from 30 to 40 centimetres, and a plow similar to that shown in plate 3 should be used.

To begin deep plowing, 30 centimetres will be deep enough. After several years it may be made 40 centimetres, but should be deepened only gradually, because if too much dead soil comes up the land is ruined for at least one year. Deep plowing should always be done before winter, so that the frost has time to work on the soil.

Steam plowing.—By the introduction of the steam plow an implement was put into the hands of the farmer the work of which can not be equaled. The reasons why the steam plow works so well are—

(1) By the speed with which it operates the soil is well mixed and pulverized.

(2) The depth of all the furrows is the same.

(3) It plows to any depth, especially in heavy soils, which would require a large number of animals. Generally the soil is loosened to a depth of 35 to 40 centimetres, and the plants are enabled to take nourishment from a larger quantity of soil.

(4) In dry seasons soils plowed by steam retain longer their humidity. In wet seasons the water descends quicker to the subsoil. The steam plow increases the crop and renders it certain.

(5) The animals leave footprints (four oxen make about three hundred and sixty thousand in plowing 1 hectare), and therefore cause a not unimportant loss.

(6) It is possible to work in spring and fall, when with animals it would be impossible.

(7) A large number of animals can thus be used for other purposes.

If we consider that with a steam plow 3 hectares can be plowed in a day, while with a common plow one-third of a hectare can be gone over, then nine common plows are needed to do the work of one steam plow; and, as four oxen are needed for each plow, 36 oxen would be employed, and as they should be used only half a day, 72 oxen would be required, and their work is not equal to that of one steam plow.

The excellent work of the steam plow can increase the crop of beets

from 4,000 to 5,000 kilograms per hectare. The cost of plowing by steam is between $11 and $16 per hectare for a depth of 32 to 40 centimetres.

Deep plowing can be done in such a way that two plows go one after the other, the first cutting 15 to 20 centimetres deep and the second 10 to 18 centimetres.

Another way to loosen the deeper soil is as follows: The land is plowed from 15 to 20 centimetres, and laborers then spade up the deeper soil from 20 to 24 centimetres, the under soil being scattered over the surface. This method is expensive, but produces very good results.

Still another way to procure most of the advantages of deep plowing, and one which is generally used on very heavy soil or on lands exposed to inundations, which consequently dry at a late period, is to form ridges.

This is done in the following manner: The land is plowed in the fall in such a way as to form ridge. For this purpose a hill plow is used, or a machine invented by Dr. Bärtel and called a "ridge former."

In spring these ridges are split, and thus new ridges are formed. These must be rolled to an even surface.

The advantages of preparing the land in this way are: The water gathers in the furrows and runs off; the soil in the ridge is always in a good condition and the air can penetrate it.

If grain has been grown on land about to be planted in beets the preparation goes on in the following way: The stubble is plowed as soon as possible to a depth of 5 to 8 centimetres. For this work gang plows are used.

As soon as weeds come up the land is harrowed and rolled. Before winter the deep furrow is plowed, and, if stable manure is used, it should be applied before the middle of November. In such cases only a moderately deep furrow is needed, because, as before remarked, the manure thus decomposes better.

The land remains in this state during the winter, and is therefore exposed to the influence of frost, rain, etc. In spring it is ready for the beets. Then, as soon as possible, it should be harrowed. The harrows used are, if the land is crusted, "the Extirpator," or if necessary it must be plowed 15 centimetres deep, then the "Acme" harrow is used.

If sugar beets follow beets, potatoes, or corn, the land is simply plowed before winter.

Before planting all land should be rolled.

PLANTING.

The time of planting influences the crop in a high degree.

It is shown that in a warm, dry season the crop of an early planting is larger than in a cold, humid season. The time of planting is the middle of spring, with a temperature of from 9° to 12° C. (48° to 54° F.). Early planting begins with April and lasts until the end of that

month; late plantings in May. In general, early planting is to be preferred, because the danger from frost is not so great as that of drought. It should always be remembered that the seeds should be put in a soil warm enough to germinate in 6 or 8 days, not 12 to 16 days, as is the case in cold, humid soil.

Distance apart.—This has a great influence on the crop and the quality of the beet. The experiments of Valmorin show that the largest crop will be grown if the beets be planted comparatively near together. If the distance increases, the proportion of leaves increases. The lighter and poorer the soil the farther must the beets be planted apart, and experiments show that this influence is greater than that due to manuring, or even the choice of the variety. Distances vary from 30 to 50 centimetres from row to row and from 10 to 25 centimetres in the row.

Depth for planting.—The seeds need only a very light covering—2 to 3 centimetres is the right depth. If part of the seeds are not covered at all it does not cause so much damage as if they are covered too deeply.

CULTIVATION.

From the time of planting up to that of harvesting the following suggestions should be observed: As soon as the sowing is done the roller must be used, because in pressing the surface the humidity, which is very necessary for the process of germinating, is drawn by capillary attraction out of the deeper soil, and the surface is thus kept moist. The roller may be smooth or have rings; the latter is better, because it makes the surface of the land rough, and therefore a heavy rain can not form a crust. If after sowing a crust covers the field the ring-roller is the best implement for breaking it, and after this a light harrow is recommended. Thus is the soil loosened, the air can enter, and germinating and growing are facilitated. When the plants have grown so that the rows are visible hoeing must be done, and the earlier the better, not only because the weeds are destroyed, but also because the plants need a loosened soil. The oftener the plants are hoed the better will be the crop as regards quantity and quality. Indeed, quantity and a high sugar percentage can only be obtained by hoeing. The first hoeing must be only superficial, that all the weeds are thrown on the surface to dry, and care must be taken that no soil covers the young plants. The hoeing should be done even if the land be dry, as hoeing prevents the evaporation of the water from the deeper soil. If laborers can be had, it is preferable to first hoe by hand in such a way that only the soil about 50 centimetres distant from the beet is hoed and the soil between the rows is untouched. This is then hoed with the cultivator. If hoeing must be done by horse-power a cultivator is used.

After the hoeing comes thinning out. This must be done as early as possible, and generally plants sowed by the Dippel machine must be

thinned out earlier than those planted by the drill, the reason being that the latter have more light and air than the former. It is practical to thin out when the plants have three or four leaves. The root is then as thick as a straw, and the whole plant has a length of 8 to 10 centimetres.

If planted with a drill, the work of cultivating can be done in two ways:

(1) The field is crossed with the cultivator at right angles to the rows, and the knives are set so that they leave about 2.5 centimetres on each side of the beet untouched. Of the plants which remain in this space the weakest are removed by hand.

(2) The whole work is done by hand. By means of hoes the laborers remove the superflous plants, leaving spaces about 20 to 25 centimetres between. Children are employed here for this work, as they can best get down to it.

Cutting the leaves off is not sufficient, as the leaves grow again; or, if not, the plant becomes a harbor for insects. One person can thin out one-ninth to one-eighth of an acre a day. After thinning, hoeing by hand should follow immediately to loosen the soil around the plants; then between the rows should be hoed, and the time this should be done depends upon the weeds and the soil. As a rule, the intervals should not be more than a fortnight. A fourth, and possibly a fifth, hoeing would increase the crop. Of course hoeing can not be done when the plants are large enough to be damaged.

Hilling up now follows. This must be done, because by covering the beets with soil it prevents the heads from growing out, and therefore this part of the root, which is of no value to the manufacturer as it contains little sugar, is lessened; water can run off and evaporate better, and the soil will not become incrusted. In heavy soils this is a very important point. The time for hilling up is important, as if this is done too early the plants are buried, and if too late the leaves are damaged. Hilling up can only be done when the soil is in good condition—*i. e.*, neither too wet nor too dry. For this a plow can be used with a single share, or that already shown in Plate 5. On small farms it is usually done by hand.

ENEMIES OF THE SUGAR BEET.

The insects which do the most damage to the root are—

(1) The larvæ of the May bug. Remedies are to collect the bug and leaves and encourage protecting birds and moles.

(2) The larvæ (wireworm) of the *Elater lineatus*. Remedy is to gather the leaves.

(3) *Atomaria linearis*. Remedy is not to plant successive crops of beets, and to wash the seeds in a liquid composed of 100 parts water, 5 parts Epsom salts, and 1 part of carbolic acid. In this fluid the seeds should remain 20 minutes.

(4) Caterpillars of *Agratis segetum* (Noctua *seq.*). Remedy is deep plowing and gathering the insect at night with a lantern.

(5) *Julus gullulatus et terrestris.* The remedy for this formidable-sounding insect seems to be like that in the preceding cases—*i. e.*, the best thing to do is to catch the bug.

(6) *Heterodera spachtie nematode.* This insect caused the disease of the soil which produced the so-called "fatigue of the beet." Remedy is to sow plants in which to catch the insects. The best is the *Ropia brassica rapaoleifera.*

Insects which damage the leaves are—

(1) *Silpha apaca.* Remedy, distribution of dead animals in the soil, as the larvæ prefer flesh.

(2) *Cassida nebulosa.* As this insect is attracted by the weeds the latter should be carefully removed.

(3) Larvæ of *Cleonus sulcirostris et punctiventris.* Remedy is its collection and remvoal.

(4) *Plusia gama.* Remedy, collecting.

(5) Larvæ of *Anthomya conformis.* Remedy is to hoe it on the surface where the birds can get it. Collect it with the leaves, if necessary, and burn them.

(6) *Hattica nemorum.* Remedy is to plant early enough that the plant can resist the attacks of the insect; also destroy them.

Parasites which injure the plant are—

(1) Rust, caused by *Aeromices betæ.* Remedy, the leaves of the beets used for raising seed, and which show attacks of the parasite, must be destroyed.

(2) Mildew of beets (*Peronospora betæ*). Remedy, beets used for raising seeds must be carefully selected and, if mildew is observed, the beet must be rejected. In spring, before planting, the same precautions must be again taken.

(3) Beet rot, caused by *Rhizætonia violacea.* Remedy, in storing, to separate the affected beets from the sound ones.

(4) Smut, caused by *Helminthis parium rezoctonia.*

(5) Leaf dryness, caused by *Dapazea betæcula.*

(6) Rot of the heart, caused by *Sporidium putrifacieum.*

(7) Rot of the beet.

It is possible that the sugar-beet may meet in the United States with a still more formidable enemy, though bearing a less imposing name, viz, the "sugar trust." No doubt, however, the remedy used in so many of the cases above mentioned may also be used here.

HARVESTING.

This is done when the beets are ripe, *i. e.*, when growing stops and all the products of the leaves go to root, where they are deposited. In Bohemia beets ripen from the end of September to the middle of October.

Signs of ripeness.—The leaves become yellowish green, fall, and form a kind of wreath around the plant. The middle leaves, so-called "heart leaves," also of a yellowish green, do not fall.

Harvesting should not be too early, as the loss occasioned thereby may amount to as much as 2 per cent. Of course harvesting must take place before heavy frost, though the beet can stand frost from 3° to 4° C. (24° to 27° F.). If early frosts should come, it is best to let the beets thaw in the soil, as the loss will be thus lessened.

How harvesting is done.—(1) By hand. To each man is apportioned a certain tract of land, which he works by contract. The soil around the plant is loosened, and then the plant is drawn from the ground by hand. Work with the fork would be easier, but might injure the beet.

(2) By team. A subsoil plow is used, which should be set for a depth of 35 centimetres. A still better implement is the beet-lifter. This machine can be worked by a boy, and also does not injure the plants, which are left loosely standing upright in their places, where they are better protected against sudden rain or frost than if lying upon the ground. As work can be done much faster with the lifter than by hand, this machine will no doubt be of much use in the United States.

Cutting off the heads.—The green heads must now be cut off, as they are of no use. This is done in the field, and here it is the work of women and girls, who accomplish their work rapidly, using sharp knives. About 1 to 2 centimetres of the beet is removed.

Piling up the beets.—This is necessary, as it is impossible to immediately transport an entire crop to the factory, and they must be protected from rot and frost. Perhaps the best plan is that recommended by Knauer, especially if the beets must remain a long time on the field. A ditch 1 foot deep and 6 feet wide is dug, and of the required length. Beats are then piled up with roots toward the center for a height of 1 foot and covered with 6 inches of soil. Then another layer of beets, covered also, is added, and then another, until the pile, tapering, is of the shape of a prism. If the soil is very dry, water should be applied. Beets so buried will keep six or seven months with little loss.

It is best to grow only one crop in 4 or 5 years on a single field, as otherwise the soil will be exhausted and insects and parasites increase, so that great losses would occur. Beets should follow grain or barley, and after the beet the best crop to plant is barley.

RAISING SEEDS.

If the beet industry were fully introduced into the United States one of the first subjects that our people would have to consider would be the raising of seeds, as in Germany and Austria the supply is only able to meet the present demand. The beets selected for raising seed should possess all the attributes of a good beet as previously described.

For ascertaining the proportion of sugar in the beet a piece is taken from the middle and the specific gravity of its sap found. This is, however, inaccurate, and the best plan is to submit the sap to polarization.

For raising seeds stable manure is unsuitable, but phosphate is highly recommended. This can be applied in the spring by grubbing. The cultivation of the beet then goes on in the manner already described. The seeds are ripe when they look meal-like if cut. The main sprouts ripen earlier, and therefore harvesting must begin with these. The plants are cut off with sickles, bundled up, and put away for drying. Threshing is generally done by hand, either on the field or at home. If done on the field, a cloth is spread, upon which the work is done. The seeds are then cleaned and ready for storing. If stored properly they should retain their generating power from 4 to 5 years. The crop from 1 hectare should be from 15 to 35 metre centners (3,360 to 7,740 pounds).

It should be mentioned that the seed beets, after being carefully selected, are buried in the ditches. In the spring these are carefully set out and cultivated with great care. Upon ripening the leaves are gathered and treated as above described.

Prof. Anton Veith, director of the agricultnral college here, whose assistance has been invaluable to me in the preparation of this report, submits the following suggestions for the American farmer. As Professor Veith is thoroughly familiar with the subject of beet culture, and furthermore spent 2 years in America studying our farming methods from New York to California, his hints will be found practical. The professor also kindly expresses a willingness to answer any inquiries made to him on the subject of beet culture.

HINTS TO AMERICAN FARMERS.

[By Professor Veith.]

In traveling through the United States I was astonished to find that an industry so highly developed in the old country was nearly unknown there.

The influence of such an industry as the fabrication of sugar from beets exerts such a great influence upon a country that it deserves all the support of a great government.

In 1887 there was only one beet-sugar factory in the United States, and that was in Alvarado, Alameda County, Cal.

Upon inquiring as to the cause of this, I heard that several factories had been started in Illinois, but that after a few years had to be closed, as they did not pay.

I was told by the editor of a rural paper in Chicago that the soil was unfit for the purpose; by a professor in Kansas that beets would not grow containing a high enough percentage of sugar; by a chemist in Washington that the cultivation and manufacture had not been properly carried out.

The last opinion was undoubtedly the correct one.

The United States possesses soils of every kind, and in every State where wine and corn are grown it is surely possible to raise sugar beets.

But in raising sugar beets the American farmer, especially of the Western States, must get rid of the idea of always trying to save labor. Sugar beets need much work, but they pay double or treble as much as any other crop.

Localities are to be preferred where there is a large population, plenty of transportation facilities, providing always the climate and soil are suitable.

Raising sugar beets on a large scale, as is the case with grain in America, is impos-

sible, as labor is dear and it is impossible to get sufficient help for a few weeks' work. I think the plan adopted by Claus Spreckels, in California, is the best. Here small farmers who do their own work with little help raise the beets and sell them to the factory. A better plan would be for a number of such farmers to form an association and erect a factory themselves. We find such associations in Germany, and they do very well.

In order to stimulate the farmer to raise beets of a high sugar quality, the factory should pay in accordance with the sugar percentage, *i. e.*, to demand a certain percentage, say 9, and pay extra for any increase over this figure.

Raising sugar beets gives the farmer a chance not only to get more out of his land than possible with other products, but also improves his land for other products.

If the farmer sells the beets to the factory and gets back the pulp for feeding and perhaps the mud or lime, he loses very little of the mineral substance from his soil, as the sugar-producing substances are absorbed by the plants from the air.

Raising beets improves the land, because the thorough cultivation necessary brings it to a perfection never to be attained with other crops. The land will also be clearer of weeds.

In raising beets the whole agriculture of the country must be changed, *i. e.*, brought from an extensive culture to an intensive one.

In raising corn, grain, fodder, etc., the farmer uses only the upper part of his land and not the subsoil. If sugar beets are planted, the deeper soil is also placed at the service of the owner.

In connection with the improvement of the land, cattle raising is also improved, as the waste furnishes excellent fodder for milk as well as for fattening. An increase of manure can therefore be produced.

The first thing a farmer should do is to procure proper seeds, and these he should raise himself.

As implements are expensive, those should be procured which can be used for various purposes, as the universal plow of Sack.

For planting seeds it is recommended to try the corn-planter.

In closing I would only state that there exists a great future for beef culture in the United States (and I would recommend that careful experiments be made) and that the success which has already greeted Claus Spreckels in California be followed in other quarters.

Sugar-beet crop of Austria-Hungary.

Provinces.	Crop.			Planted in sugar beets.		Crop raised on 1 hectare.	
	1886.	1887.	1888.	1887.	1888.	1887.	1888.
	*Met. cent.**	*Met. cent.**	*Met. cent.**	*Hectares* †	*Hectares.*†	*Met. cent.**	*Met. cent.**
Lower Austria	.....	383, 760	730, 690	2, 578	2, 578	135	169
Bohemia	.....	15, 301, 600	27, 400, 460	91, 830	120, 060	154	190
Moravia	.....	7, 639, 650	10, 523, 930	51, 142	62, 800	137	152
Silesia	.....	788, 630	887, 820	4, 024	4, 165	182	175
Galicia	.....	444, 500	551, 450	4, 445	4, 625	100	120
Total	32, 984, 870	24, 558, 140	40, 094, 350	154, 019	194, 228	‡141. 6	‡161. 2

*1 metre centner=220 pounds. †1 hectare=2.47 acres. ‡Average.

MANUFACTURE OF SUGAR.

We have now traced the cultivation of the beet from the preparation of the land to the moment when the root, minus its useless head, is ready for fabrication. In studying the subject of this report, then, I have to ask my readers who have accompanied me through the great

beet fields of Bohemia, where we have seen the various stages of cultivation, to now leave the farm and enter with me the greatest sugar factory in Bohemia. And here I may remark that, while this paper is not intended to give more than a superficial idea of the process of manufacture of sugar—and machinists and engineers are referred to the books mentioned for detailed information—I have found it necessary to go somewhat into technicalities and to employ plates to illustrate the various processes. Without this the general reader could not possibly get an intelligent idea of the subject.

Standing in the courtyard of the great factory referred to, we see wagon after wagon dumping its load, for each of which the farmer gets a receipt. No price has yet been fixed, but the farmer must sell to the factory, as beets can not stand transportation, on account of their weight, as already explained. The price will be fixed later by the manufacturer, who is, indeed, the Great Mogul of the neighborhood, and could exclaim with Napoleon: "*L'etat, c' est moi.*"

Through the middle of the court referred to runs a ditch lined with perfectly smooth tile, through which a rapid stream of water carries the beets to the washing machines, where all dirt and stones are removed.

It may be here remarked that while there are two ways of extracting the sap from the beet, viz, by pressure and by diffusion, only the latter is employed in this neighborhood. The advantages of the process of diffusion are: The cheaper plant required less workmen and force, ease of keeping apparatus in order, simple inspection of the work, its cleanliness, easy increase of work without corresponding loss of sap, and the entire absence of "press cloths." The only disadvantage is the great amount of water required, which limits such factories to those localities where sufficient water can be had.

The beets having been thoroughly cleaned, an elevator carries them to the top of the building and delivers them to the cutters, where ribbed knives reduce the beet to little cuttings like vermicelli. A railway carries this material and dumps it into the "diffuser." The diffuser is an iron, cylindrical tank, made to close tightly, and supplied with pipes above and below. Nine are usually connected together, and constitute what is called the "diffusion battery." This battery forms an important a part of the sugar factory.

Passing the first eight stages through which the beets pass in this battery, we come to the ninth, with which stage begins the regular work. From now on, of the nine vessels, eight are always working, while one is emptied and filled with fresh cuttings. Each diffuser, before being emptied, is completely isolated, by closing the valves, from the rest of the battery. The operation of the valves must be in precisely the order indicated. Failure to do this will cause disturbance. For instance, the closing of the valves *u* and *s* to the right is of importance, as otherwise the water and sap will become mixed, whereby leaching will take place

and evaporation rendered more difficult. Further, it should be taken as a general rule that the sap stream should enter every operating vessel from above, except in case of the vessel just filled, when the stream is reversed and ascends from below, in order to prevent formation of foam and to drive out all air from between the cuttings.

The temperature must be right in each diffuser, or the sap, as well as the pulp, will be injured. As the sap circulation proceeds without interruption, the principal steam valve remains always open, and the regulation of the temperature is controlled by the valves from the calorisator.

We will now suppose that the sap has been all extracted from the beet cuttings and has passed over to the saturator as a dirty-looking fluid with a disagreeable taste and smell. In the diffusers remain the pulp, now of no more use in the sugar process, but of much value in other respects. A trap in the bottom of the diffuser opens and the pulp is thrown into a slide, where moderate pressure removes the water as it passes downward to the cellar, to be used subsequently for fodder, for which it is admirably adapted, especially if mixed with substances containing fat and nitrogen, as oil cake, ground corn, etc. It is stored for use in ditches after being mixed with chopped straw, and is covered with straw and soil, being packed down as tight as possible. By being stored the pulp ferments and gains in digestive properties and flavor.

We now return to the sap, which has reached the saturator, a vessel made of block tin, the use of which is the removal of foreign substances and the saturation of the sap. The saturator is half filled with sap. Lime milk is now introduced, as well as steam and carbonic dioxide. The steam must be so controlled that the temperature of the sap slowly rises until at the close of the saturation it amounts to about 85° to 90° C.

The results of the treatment with lime and carbonic acid gas are as follows:

(1) The sap, previously dirty, dark, smelling of beets, more or less slimy, and slightly acid, becomes clear, light yellow, thin in consistency, alkaline, and emits an odor of ammonia.

(2) The sugar forms with the lime a saccharate, which however, under the influence of the CO_2, is immediately resolved.

(3) The nitrogen, holding portion of the sap, is resolved through the action of the lime.

(4) The nitrogen free organic acids, as ascetic and oxalic, are precipitated as salts of lime.

(5) Coloring matters are partly thrown down and partly remain in the solution. Dextrine combines loosely with the lime.

(6) Magnesia, oxide of iron, and phosphoric acid are precipitated, and sulphuric acid is also separated, while all the other mineral substances remain in the solution.

By this process, of 100 parts of foreign matter 40 to 50 will be re-

moved. The sap contains yet, however, many impurities, and the next step is to carry it through the filter press, which removes the dirt in the form of a cake. This cake is used for manuring.

A still more important means of cleaning, and one which removes the last of the impurities from the sap, is the filtration through animal charcoal or spodium. This spodium is a charcoal made of bone, and is used in pieces as small as a chestnut, or smaller.

The filter battery is composed of several filters made of block tin, from 18 to 30 feet high and from 1½ to 3 feet in diameter.

These are filled with spodium and are packed, to prevent cooling of the sap as it passes through. Over the battery are reservoirs for water and sap. The action of the spodium upon the sap is as follows: The sugar is taken up by the charcoal, but is only loosely held, and can be easily removed with water; saccharate of lime is rapidly seized upon and precipitated as hydrate of lime and free sugar; coloring matters are energetically absorbed and can not be washed out.

The remaining organic non-sugar substances are absorbed, but are not combined with equal force. A part enters into a chemical combination, while another part is only loosely retained by the spodium, and may be again washed out.

The salts act respectively in accordance with their chemical nature.

In spite of many experiments, no good substitute has yet been found for spodium as a filter material. After being used it is washed out and then thrown into a furnace and all impurities burned out, when it is again ready for use.

The sap must now be concentrated, and this is done by steaming and boiling until the right consistency is reached to favor crystillization. As a high temperature is objectionable, use is made of the well-known physical law that boiling takes place at a lower temperature in a vacuum apparatus.

The material is now let off into cooling pans, where crystallization begins, and from here the mass is poured into block-tin conical molds, and finally comes out as the familiar sugar loaf.

A second quality of sap is conveyed to the centrifugal machines, which revolve about a thousand times a minute, with the effect of causing the crystallization of a great ring of white sugar, while the balance is drawn off as molasses, no further crystallization being possible. These rings of sugar are crushed and packed in sacks for market, constituting the so-called "pilé."

I may now mention the existing

TAXES AND DUTIES ON SUGAR IN AUSTRIA.

According to the law of June 20, 1888, there must be paid a consumption tax on sugar, whether made out of raw material or the "reste" from sugar manufacture.

	Florins.
(1) Beet and all other sugars in every degree of purity, with the exception of sirup unfit for human use.....per 100 kilograms, net.....	11
(2) Sugar of any other kind:	
As a solid	3
As a fluid	1

Export indemnity.

From August 1, 1888, an indemnity is granted on exports of sugar of the first class—

	Florins.
(*a*) For 100 kilograms, net, from 93° to 98° of polarization.....	1.50
(*b*) For 100 kilograms, net, with at least 99.5° of polarization.....	2.30

If this indemnity should amount in one year to more than 5,000,000 florins, the manufacturers are pledged to return the balance to the Government.

Duty on imported sugar.

	Florins.
(*a*) Raw sugar under Holland standard No. 19 .....per 100 kilograms.....	15
(*b*) Raw sugar under Holland standard and higher than No. 19.....	20
Refined sugar.....	20
Sugar solutions, starch sugar, grape sugar (glucose), as a solid	15
Sirup (starch sugar, grape sugar, as a liquid) and molasses.....	6

This sirup must not contain any crystallized sugar, and must not crystallize if heated. If boiled two minutes it must reduce Soldaini's solution.

Statistics of the sugar-beet industry in Austria-Hungary.

Years.	Number of factories working.	Amount of beets.		Exports.		
		Notified.	Paid tax for.	Refined sugar.	Raw sugar.	Total in raw sugar.
		Met. cent.	*Met. cent.*	*Met. cent.*	*Met. cent.*	*Met. cent.*
1867–'68	151	12, 165, 753	10, 854, 380	.....	.....	.....
1868–'69	162	9, 409, 232	7, 934, 382	5, 258	2, 452	8, 762
1869–'70	181	14, 107, 376	12, 291, 160	149, 438	362, 646	541, 972
1870–'71	215	18, 538, 173	15, 931, 191	369, 762	400, 897	844, 651
1871–'72	251	16, 114, 062	13, 624, 246	213, 594	396, 840	653, 153
1872–'73	256	20, 418, 912	17, 333, 189	233, 433	455, 262	735, 382
1873–'74	244	16, 166, 107	13, 773, 879	293, 867	495, 465	848, 105
1874–'75	226	11, 634, 409	9, 832, 973	299, 939	264, 007	623, 934
1875–'76	231	14, 969, 313	12, 780, 932	398, 775	609, 334	1, 087, 864
1876–'77	227	17, 105, 561	14, 891, 538	385, 633	688, 371	1, 151, 131
1877–'78	229	26, 310, 864	22, 846, 002	567, 300	988, 440	1, 669, 202
1878–'79	226	30, 926, 289	28, 287, 800	809, 915	1, 088, 559	2, 060, 457
1879–'80	226	28, 975, 077	26, 252, 919	605, 835	1, 546, 142	2, 273, 144
1880–'81	227	47, 308, 640	44, 097, 228	880, 095	2, 113, 493	3, 169, 564
1881–'82	230	46, 280, 701	42, 806, 735	891, 022	1, 204, 814	2, 274, 040
1882–'83	232	51, 345, 805	48, 862, 203	1, 257, 466	1, 387, 934	2, 896, 893
1883–'84	230	44, 856, 566	41, 845, 679	1, 251, 786	1, 105, 021	2, 607, 164
1884–'85	229	46, 087, 950	43, 401, 900	1, 291, 085	155, 648	3, 704, 590
1885–'86	212	28, 453, 837	26, 151, 015	1, 164, 488	683, 607	2, 080, 993
1886–'87	217	45, 589, 629	42, 870, 875	1, 697, 822	1, 010, 392	2, 896, 861
1887–'88	207	35, 226, 999	32, 263, 262	1, 243, 418	502, 349	1, 883, 926

Statistics of the sugar-beet industry in Austria-Hungary—Continued.

Years.	Receipts.			Total re-paid for evaporated sugar.	Net amount of tax over duty.	Recovered by after payments.
	Tax on beets.	Duty.	Total.			
	Florins.	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*
1867–'68	7, 352, 266	16, 010	7, 368, 276	1, 805, 117	5, 563, 159	.....
1868–'69	5, 802, 017	267, 600	6, 069. 617	77, 528	5, 992, 089	.....
1869–'70	8, 987, 911	23, 886	9, 011, 797	4, 742, 147	4, 269, 650	.....
1870–'71	11, 649, 684	10, 056	11, 659, 740	7, 306, 653	4, 353, 087	.....
1871–'72	9, 962, 730	14, 482	9, 997, 212	5, 817, 097	4, 160, 115	.....
1872–'73	12, 674, 894	23, 032	12, 697, 926	6, 410, 106	6, 287, 820	.....
1873–'74	10, 072, 149	23, 400	10, 095, 558	7, 152, 491	2, 943, 067	.....
1874–'75	7, 190, 361	10, 646	7, 201, 007	5, 458, 683	1, 742, 324	.....
1875–'76	9, 330, 081	7, 354	9, 446, 744	9, 472, 991	—26, 247	.....
1876–'77	10, 870, 823	5, 364	10, 876, 187	10, 479, 973	396, 214	.....
1877–'78	16, 677, 581	8, 477	16, 686, 058	15, 335, 217	1, 350, 841	.....
1878–'79	20, 050, 094	6, 761	20, 656, 855	18, 960, 724	1, 696, 131	.....
1879–'80	19, 164, 634	11, 150	19, 175, 784	20, 843, 110	1, 667, 326	4, 303, 869
1880–'81	35, 277, 783	8, 462	35, 286, 245	29, 994, 247	5, 291, 998	8, 167, 326
1881–'82	34, 375, 531	14, 862	34, 290, 393	21, 608, 839	12, 781, 554	4, 708, 002
1882–'83	39, 090, 563	10, 593	39, 101, 156	27, 563, 813	11, 537, 343	.....
1883–'84	33, 476, 543	8, 782	33, 485, 325	24, 833, 009	8, 652, 111	.....
1884–'85	34, 721, 521	7, 112	34, 728, 521	35, 173, 673	—445, 041	1, 810, 546
1885–'86	20, 920, 812	7, 085	20, 927, 897	19, 865, 085	1, 062, 812	12, 045, 041
1886–'87	34, 296, 700	6, 155	34, 302, 855	29, 098, 681	5, 204, 174	10, 937, 188
1887–'88	25, 810, 610	5, 947	25, 816, 557	19, 979, 946	5, 836, 611	6, 963, 389

THE SUGAR FACTORY.

The manufacture of sugar can only be carried on on a large scale. It is a great advantage for the manufacturer to own and conduct his own plantation. Water is a prime requisite, and an important matter, also, is the disposal of the water after it has been used, as it is then capable of destroying a stream for all further uses, and this would cause endless suits and annoyances. The water should be conveyed into ponds where it may evaporate or sink into the ground, or, better, distributed over the fields. The factory should be so situated that coal can easily and cheaply be obtained and the goods profitably shipped to market. It is, however, more important that it be in the immediate neighborhood of the plantation. A middling sized factory requires about 300 workmen. As the factory only works about 5 months, it is necessary, in order to secure permanent help, to employ the laborers in the field also.

THE BUILDING.

While it is not my purpose to go into the architectural features, I desire to introduce here the accompanying admirable plan, not only as exhibiting a model factory building, but as showing the relative location of the apparatus as described in the foregoing pages. The building should be in the form of a cross, with a great central rotunda.

Summary of sugar factories in Austria-Hungary.

Description.	Bohemia.	Moravia.	Silesia.	Lower Austria.	Galicia.	Hungary.	Total.
Sugar factories:							
Working	138	50	9	3	1	14	215
Not working	7	.....	.....	.....	.....	4	11
Refineries:							
Working	10	4	1	.....	.....	.....	15
Not working	.....	.....	.....	.....	.....	.....	.....
Total	155	54	10	3	1	18	241
Sap extraction:							
By diffusion	138	50	9	3	1	14	215
By pressing	.....	.....	.....	.....	.....	.....	.....
Production:							
Only raw sugar	120	33	5	1	.....	4	163
Raw sugar and white goods	20	17	3	2	1	8	51
Only white goods	8	4	1	.....	.....	.....	13
Only pilé	1	.....	.....	.....	.....	2	3

JOHN B. HAWES,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Reichenberg, November 8, 1889.

FRANCE, 1874.

REPORT BY CONSUL-GENERAL TORBERT, OF PARIS.

The manufacture of beet-root sugar began in 1812, in consequence of the continental blockade. It constitutes now one of the most important products of France. It is almost entirely confined to the five departments of Aisne, Nord, Oise, Pas-de-Calais, and Somme. Out of 508 establishments engaged last season 181 were situated in the single department of the Nord, 92 in Pas-de-Calais, 60 in the Somme, 39 in the Oise, 89 in Aisne, and 47 divided among eight other departments.

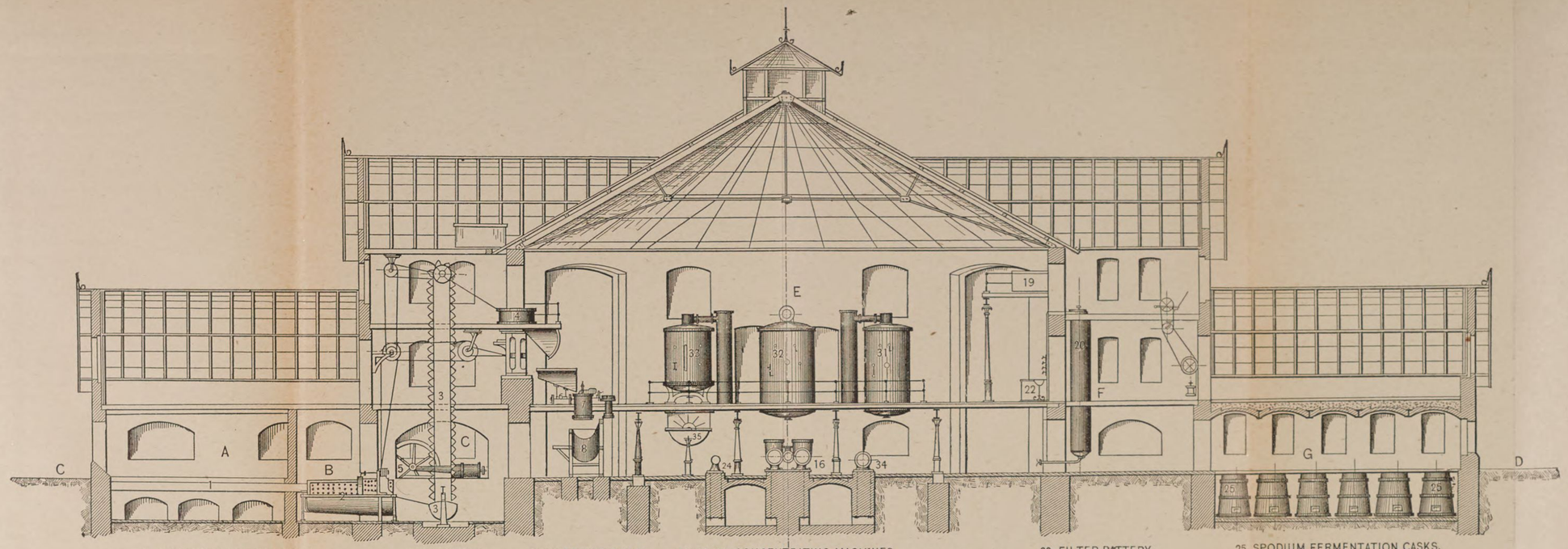
The following table illustrates the development of this product during the past few years:

	Pounds produced.
1868	304,950,533
1869	533,843,890
1870	612,285,762
1871	741,294,545
1872	828,041,146
1873	916,511,742
1874	957,581,885

Sugar refining has also considerable importance, and constitutes a very large item of revenue.

A. T. A. TORBERT,
Consul-General.

UNITED STATES CONSUL-GENERAL,
Paris, October 30, 1875.

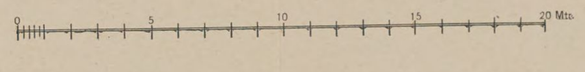


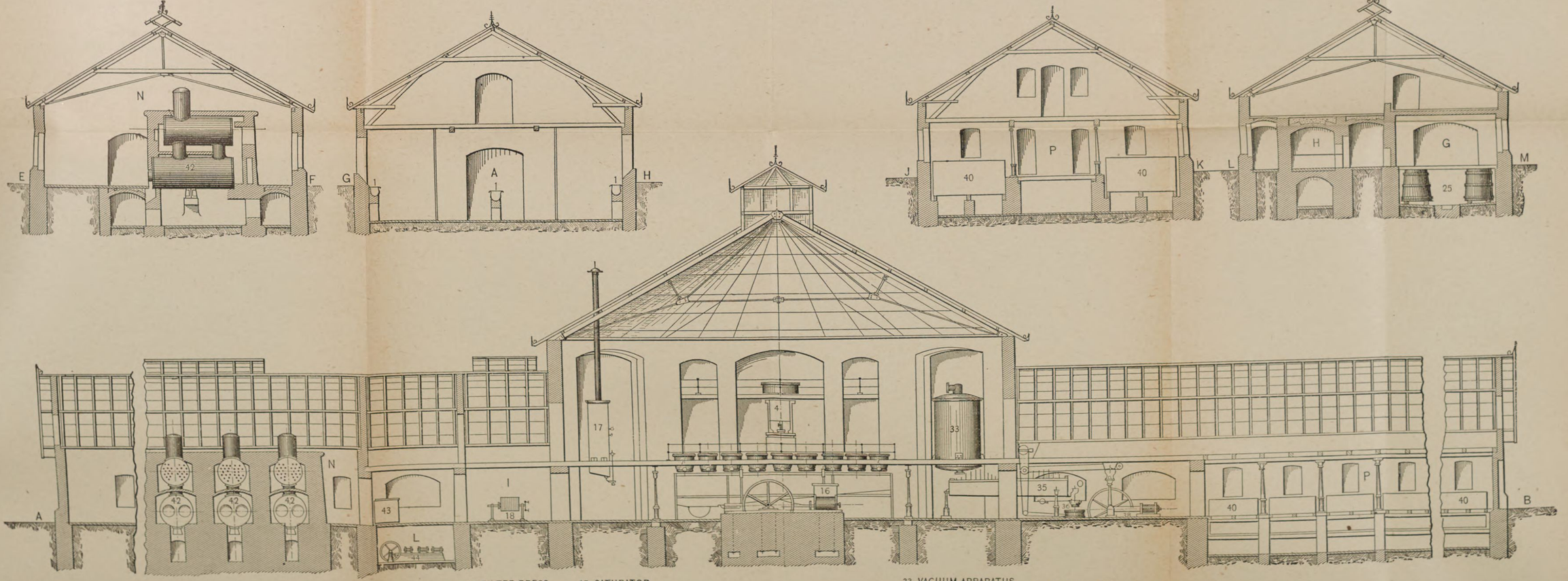
1. HYDRAULIC BEET TRANSPORT. 3. ELEVATOR. 8. SLIDE FOR PULP. 33, 32, 31. CONCENTRATING MACHINES. 20, FILTER BATTERY. 25. SPODIUM FERMENTATION CASKS.

2. WASH-MACHINE. 4. CUTTING-MACHINE. 35. COOLER.

5. ENGINE. 6. RAILWAY.

7. DIFFUSION BATTERY.





18. FILTER PRESS. 17. SATURATOR. 33 VACUUM APPARATUS. 36. CENTRIFUGAL MACHINES.

DENMARK.

DENMARK—1886.

REPORT OF CONSUL RYDER, OF COPENHAGEN.

The rapid and very great development which has taken place in the manufacture of beet sugar in this country in the last years, namely, from 4,000,000 pounds in 1880 to over 20,000,000 pounds in 1884, has been a source of material benefit in these times of unusually low grain prices to the agricultural classes, more especially to the agriculturists located in the vicinity of the districts where the large sugar refineries have been erected. These parties have been anxiously seeking every opportunity for bringing an increased area of their lands under culture of these roots; but unfortunately, with the simultaneous depression which has been felt in the sugar markets, due, in great measure to the large exports from Germany and France under the protective influence of the sugar-export bounties, the owners of the large sugar refineries in this country have found themselves compelled to refuse to enter into fresh agreements for any increased areas, upon conditions of similar nature to those contained in still running contracts. Taking further into consideration the present unfavorable aspect of the world's sugar markets, they have decided to limit all new contracts to the term of 1 year's duration, as likewise to call for a reduction of about $2\frac{3}{4}$ cents per hundredweight of roots on the prices hitherto paid. The fresh agreements thus determined upon by the owners of the refineries have produced a feeling of sad disappointment amongst a large number of the older contractors. They had commenced operations upon a small scale, with the view of first acquiring full experience in the cultivation of this product, but with the full expectation that if the results responded favorably to their hopes, that they would then be enabled to place under the same culture such increase of area as might be fairly counted upon for a reasonable supply to the sugar works.

Again, many husbandmen, who with still greater caution had not ventured to embark at once in the same undertaking, but had preferred first to watch the results obtained by their neighbors before they also took part in the culture, now that the yearly returns have so plainly demonstrated the great advantages that have been derived by their neighbors from the culture of sugar beets during the present low prices of grain, are also anxiously looking forward to a greater development in this branch of agriculture, in which they may likewise be enabled to participate.

With the somewhat firmer tone of the sugar markets during the latter part of the expired year, a more hopeful feeling seemed to spring up among the cultivators, and it was generally felt by them that the opportunity should not be allowed to slip away without some attempt being made to obtain terms of such favorable nature as would justify

them in bringing a greater extent of area under culture of these roots; and they more especially were of the opinion that such prospects might be more easily realized when they could at the same time offer to the different newly-established refineries at Nakskov Stege and at Assens such a collective extent of area that the manufacturers could obtain full security for the carrying on of their works without interruption throughout the whole working campaign. At a numerously attended meeting lately held in the principal sugar-beet district it was unanimously resolved to send a deputation from the growers, who should without delay seek to enter into negotiation with the proprietors of the sugar refineries with the view of establishing a basis of agreement leading to an increased area being brought under culture of these beets upon terms of mutual advantage to the refiners as well as to growers.

It was suggested at this meeting that, as a starting point in these negotiations, it would be desirable first and foremost to seek to establish a fixed connection between the prices of sugar and the prices of the sugar beets, in such manner that, with a stipulated price of sugar according to the quotations of the London market, the growers should receive the hitherto normal prices paid for the roots (21.44 cents per hundredweight of roots without regard to their saccharine contents, or else 20.10 cents—an extra payment of 1.34 cents percentage of saccharine in the roots, over and above 12 per cent.; as also the respective prices of 22.25 and 23.30 cents after the 15th November and 15th December); and with a decline in the price of sugar, that a fixed scale should be regulated for a corresponding reduction in the price to be paid for the roots; or, again, that a somewhat lower price for the roots (say of 1.34 cents per hundredweight) might be fixed, the same to be maintained without regard to any corresponding fluctuations in the sugar market.

It would appear to have been the general feeling of all who attended this meeting that it could not be too forcibly impressed upon the minds of those who might be delegated to take part in these negotiations, that no satisfactory and lasting arrangement could be looked for unless the interest and welfare of the refineries were taken into consideration equally as well as those of the growers.

Meetings have been subsequently held in the less important sugar-beet districts, where it was also unanimously resolved to send delegates who should coöperate with the deputation from the first-named district.

Although the yield of sugar beets per area of land at Assens was stated to have been considerably less than that obtained on the islands of Moën and Leolard it was nevertheless fully acknowledged at the meeting held at that place that a greater development of the culture of these roots was a matter of great pecuniary importance under the present agricultural depression, and that it was therefore most desirable that all endeavors should be made towards bringing an increased areal under culture of these roots. The parties so deeply interested in the prosperity and further development of this branch of industry would

appear to have taken very sensible and practical steps towards arriving at an amicable arrangement, and it is to be hoped that with a mutual display of good will on the part of refiners as well as growers, that such satisfactory basis may be agreed upon as may allow of an increased areal to be brought under this culture, and that all parties concerned may find themselves in a position to tide over this seemingly interminable period of trade depression.

HENRY B. RYDER,
Consul.

UNITED STATES CONSULATE,
Copenhagen, March 25, 1886.

GERMANY.

GERMANY—1861.

REPORT BY CONSUL SUNDELL, OF STETTIN.

Formerly a good number of United States vessels entered here yearly, bringing either whale oil, rosin, dyewood, and turpentine from there, or raw sugars from the West Indies, and coffee from Brazil. But the price of the first article having advanced so much that it could not be purchased any longer, it has been replaced by the flax and the rape-seed oil, now extensively manufactured in this country; and from a singular protection given the fabrication of sugar made from the white-beet root, a discovery deserving its own chapter, the importation of the India sugar has become almost prohibited all over the German states.

Since the introduction of beet-root sugar within the "Zollverein" much thought has been devoted to the subject, and frequent conventions have exhausted themselves in deliberations over how to raise sufficient revenue from the product, and at the same time protect the manufacturers thereof. In the latter they have undoubtedly succeeded, but the people have now a poorer sugar at higher prices than before, and it is being demonstrated that the Prussian Government now receives some two million thalers less in revenue from the article (sugar) than during the time when colonial sugar was imported. Thus we have the significant fact of how a comparatively few favored individuals are allowed to grow rich at the expense of the national treasury and the people at large. It is now thought, however, that when, with the termination of the present "Zollverein" in 1865, this protection also shall have ceased, it will not be reëstablished again on the same terms, but the beet root will then be left to compete with other saccharine matters, and colonial sugars will once more be brought to the German markets. It is also argued that, with a change in the Prussian ministry in favor of free trade, the protection of the beet root fabrication, as far as Prussia is concerned, would at once be slackened so as to allow other sugars to come in for competition.

STETTIN, *March* 31, 1862.

GERMANY—1864.

Amount of duty on foreign sugar and beet-root sugar in the Zollverein from April 1, 1863, *to March* 31, 1864.

	States.	Sugar paid import duty.							
		Loaf sugar.		Brown or raw sugar.		For home refineries.		Sirup.	
		Importation.	Duty 47 7/3 per cwt.	Importation.	Duty.	Importation.	Duty.	Importation.	Duty.
		Zoll. lbs.	*Thalers.*	*Cwt. lbs.*	*Thalers.*	*Cwt. lbs.*	*Thalers.*	*Cwt. lbs.*	*Thalers.*
1	Prussia	398.55	2,922	220 60	1,323	295,178 97	1,254,510	42,152 7	105,380
2	Luxemburg	.83	6	3	.....	.....	.....	137 56	343
3	Bavaria	415.05	3,043	58 7	348	.....	.....	1,817 23	4,543
4	Saxony	155.31	1,138	17 27	103	67 58	287	10,108 64	25,271
5	Hanover	550.01	4,033	79 8	474	64,057 17	272,242	24,116 11	60,290
6	Wurtemburg	244.00	1,791	4 13	24	.....	.....	437 18	1,092
7	Baden	285.55	2,094	1 80	10	15,026 47	63,862	933 15	2,337
8	Hesse Cassel	20.88	153	4	1,035	.....	.....	94 68	236
9	Hesse Darmstadt	83.26	610	172 57	.....	.....	.....	1,047 37	2,618
10	Thuringia	25.51	187	37	2	.....	.....	2,336 12	5,840
11	Brunswick	6.40	46	2 89	17	.....	.....	2,250 24	5,625
12	Oldenburg	242.00	1,774	4 70	28	.....	.....	3,587 9	8,967
13	Nassau	42.58	312	1 95	11	.....	.....	.....	.....
14	Frankfort-on-the-Main	5566	408	96	5	.....	.....	457 18	1,142
	Total	2,525.82	18,517	564 46	3,380	374,330 19	1,590,901	89,476 62	223,684

	States.	Beet root paid duty.		Total duty.	Bonifications for sugar exported.	Net balance.
		Beet root.	Duty.			
		Cwt. lbs.	*Thalers.*	*Thalers.*	*Thalers.*	*Thalers.*
1	Prussia	34,189,599 50	8,547,399	9,911,537	374,731	9,636,806
2	Luxemburg	405,304 00	101,323	350	.....	350
3	Bavaria	80,070 00	20,017	109,261	.....	109,261
4	Saxony	142,455 00	35,613	46,819	.....	46,819
5	Hanover	1,184,795 50	296,198	372,655	2,480	370,175
6	Wurtemburg	987,303 00	246,825	209,108	.....	299,108
7	Baden	13,790 00	3,447	315,131	.....	315,131
8	Hesse Cassel	243,959 30	.....	3,838	.....	3,838
9	Hesse Darmstadt	2,420,721 50	60,989	4,264	.....	4,264
10	Thuringia	.....	605,180	67,020	1,100	65,920
11	Brunswick	.....	.....	610,870	151,185	459,686
12	Oldenburg	.....	.....	10,771	.....	10,771
13	Nassau	.....	.....	324	.....	324
14	Frankfort-on-the-Main	.....	.....	1,557	.....	1,557
	Total	39,667,997 50	9,916,999	11,753,506	429,494	11,324,010

Quantity of raw beet root worked into beet-root sugar from September 1, 1863, *to August* 21, 1864.

States.	No. of factories.	Beet roots paid duty.				
		From Sept. 1 to Dec. 31, 1863.	1st quarter, 1864.	2d quart'r 1864.	July and Aug. 1864.	Total.
		Zoll. lbs.	*Zoll. lbs.*	*Zoll. lbs.*	*Zoll. lbs.*	*Zoll. lbs.*
Prussia	221	20, 084, 713. 00	19, 933, 897. 50	166, 285	2, 495	34, 187, 290. 50
Luxemburg	.....	.....	.....	.....	.....	.....
Bavaria	6	234, 599. 00	169, 510. 00	18, 335	.....	422, 244. 00
Saxony	1	47, 785. 00	32, 285. 00	.....	.....	80, 070. 00
Hanover	1	90, 300. 00	52. 155. 00	.....	.....	142, 455. 00
Wurtemburg	6	648, 208. 14	560, 440. 00	82, 639	.....	1, 247, 287. 14
Baden	1	323, 163. 00	291, 504. 00	350, 325	179, 480	1, 144, 472. 00
Electoral Hesse	1	.....	13, 790. 00	3, 570	.....	17, 360. 00
Hesse Darmstadt	.....	.....	.....	.....	.....	.....
Thuringia	2	125, 597. 00	118, 362. 00	1, 551	.....	245, 510. 00
Brunswick	14	1, 370, 311. 50	1, 050, 411. 00	3, 910	.....	2, 424, 631. 50
Oldenburg	.....	.....	.....	.....	.....	.....
Nassau	.....	.....	.....	.....	.....	.....
Frankfort	.....	.....	.....	.....	.....	.....
Total	253	22, 924, 576. 64	16, 178, 353. 50	626, 615	181, 975	39, 911, 520. 14
Total in 1862–'63	247	21, 740, 040. 30	14, 398, 833. 56	428, 393	151, 992	36, 719, 258. 86
In favor of 1863–'64	6	1, 184, 536. 34	1, 779, 519. 94	198, 222	29, 983	3, 192, 261. 28

GERMANY—1865.

REPORT BY CONSUL KLANPRECHT, OF STUTTGART.

Owing to a very poor crop of sugar beets, the sugar factory at Stutt gart consumed last year only 192,000 centners of beets, (265,000 in 1864); the manufactory at Heilbronn, 314,982 centners. The total value of the product of the latter establishment was 650,000 florins. Prices were for prime, 28½ florins; farin, 20½ florins; molasses, 2 florins. Stockholders received a dividend of 15 per cent. on their investments, the highest ever divided since the foundation of the establishment in 1855. Up to this year an average profit of 6 per cent. only was attained. The manufactories of Zuttlingen and Althausen do not show more favorable results. The market price of beets remained stationary. This year, also, the prospects are improving, the returns of the crops indicating an abundance of beets; higher prices of sugar, therefore, can not be expected.

There were raised in the Zollverein States last year 41,641,204 centners of beets, producing a total value of 100,000,000 of florins. Manufactories and quantities of their consumption in 1865 are distributed as follows through the States of the Zollverein:

States.	No.	Quantity of beets.	Product.
		Centners.	*Centners.*
Prussia	234	35, 623, 805	153, 093
Bavaria	6	363, 071	60, 512
Saxony	1	84, 400	84, 400
Hanover	1	126, 020	126, 020
Wurtemberg	5	1, 104, 408	220, 881
Baden	1	1, 085, 371	1, 085, 371
Hesse Cassel	1	29, 376	29, 376
Thuringia	2	211, 055	105, 527
Brunswick	18	2, 813, 698	156, 316
Total	269	41, 441, 204	2, 021, 496

Eleven and a half centners of beets on an average furnish a centner raw, or 82 pounds, of refined sugar. There were produced from 41,641,204 centners of beets 2,869,200 centners of refined sugar, at a value of 89,076,000 florins. In reality a larger quantity of refined sugar was made; the secondary products, viz., molasses, residue from pressed beets for fattening animals, also being of some value.

According to the same rate, Würtemberg last year should have produced 78,784 centners of refined sugar, at a value of (30 florins per centner) 2,362,440 florins; or, including the surrounding products, of 2,500,000 florins.

EMIL KLANPRECHT,
Consul.

UNITED STATES CONSULATE,
Stuttgart, April 30, 1866.

GERMANY—1867.

The harvest of sugar beet will be about one-fourth larger than last year. Prices are from 28 to 30 kreutzers per centner. Manufacture of beet sugar did not prove remunerative last season. Overproduction of the article, together with the unfavorable state of monetary affairs, caused a reaction in prices to a lower rate than ever was heard of before. Many sales did not bring the cost of manufacture. Orders from France and England to the amount of 1,000,000 centners prevented a still greater reduction of prices. Sales are, for prime, 26½ florins; farin- 20½ florins per centner. Last year the 6 factories at Würtemberg con, sumed 1,636,097 centners of beet root.

EMIL KLANPRECHT,
Consul.

STUTTGART, *December* 31, 1867.

GERMANY—1861–1878.

REPORT BY CONSUL-GENERAL KREISMANN, OF BERLIN.

The cultivation of sugar beets steadily continues to grow in importance, and the manufacture of beet sugar has fairly become one of the leading and most profitable industries in this country. Only forty years ago no more than 20,000 acres were planted with beets, while at the present time nearly 400,000 acres of land are devoted to that purpose per annum. For fuller particulars I beg to refer to the following table:

Return of beet-sugar production in the German Zollverein.

Years.	No. of factories in operation.	Beets manufactured into sugar.	Raw sugar produced.
		Cwt.	*Cwt.*
1860–'61	247	29,354,032	2,530,520
1861–'62	247	31,692,394	2,515,269
1862–'63	247	36,719,259	2,760,847
1863–'64	253	39,911,520	3,023,600
1864–'65	270	41,641,204	3,413,214
1865–'66	295	43,452,773	3,713,912
1866–'67	296	50,712,709	4,024,818
1867–'68	293	40,593,392	3,300,276
1868–'69	295	49,953,656	4,162,805
1869–'70	296	51,697,733	4,307,645
1870–'71	304	61,012,912	5,259,734
1871–'72	311	45,018,363	3,728,838
1872–'73	324	63,631,015	5,251,021
1873–'74	337	70,575,277	5,820,813
1874–'75	333	55,134,902	5,128,247
1875–'76	332	83,225,683	7,160,964
1876–'77	328	71,000,731	5,788,453
1877–'78	329	81,819,360	7,560,181

As a matter of commercial interest it may also be stated that of the total quantity of raw sugar refined by the 64 sugar refineries existing in this country, 4,420,954 cwt. were beet sugar, while the remainder, cane sugar, amounted to only 3,699 cwt.

H. KREISMANN,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, November, 1879.

GERMANY—1871.

REPORT BY CONSUL-GENERAL SPRAGUE, OF BERLIN.

The manufacture of beet sugar is an extensive and important branch of the industry of Brunswick. There are 25 factories and 7 refineries, whose aggregate product for the year 1870–'71 was 21,000,000 kilos, valued at 5,000,000 thalers. To produce this amount of sugar 255,000,000 kilos of beets were consumed. As the average product of a hectare is about 27,500 kilos of beets, it appears that more than 9,272 hectares, or about 22,913 acres, of this little state are devoted to the cultivation of the sugar beet. The average percentage of sugar in the beets is 8, and they cost, delivered at the factory, 18 silbergroschens per 50 kilos, which includes the tax of 8 silbergroschens. The present *en gros* price for best refined is $10\frac{1}{2}$ thalers per 50 kilos. There is also a tax of $3\frac{4}{30}$ and $3\frac{18}{31}$ thalers, according to the grade, on all raw sugar manufactured; but a drawback is allowed on exported sugar. The exports of this article are chiefly to England, Switzerland, Italy, Sweden, Russia, and Holland, and now and then an invoice goes to the United States. During the past year but one invoice of sugar was verified at this office, and the value was only $363\frac{4}{30}$ thalers. The process for the production

of beet sugar has been brought to a very high state of perfection in the Duchy of Brunswick. The net earnings of some of the factories last year were from 50 to 85 per cent.

Through the kindness of Herr Eberh Mencke, of this city, I am enabled to prepare the following table, showing the amount (in kilos) of beet sugar produced in the several states of Europe during the last 6 years:

States.	1870–'71.	1869–'70.	1868–'69.	1867–'68.	1866–'67.	1865–'66.
France	295, 000, 000	285, 150, 000	213, 900, 000	225, 000, 000	216, 850, 060	274, 000, 000
Germany	252, 000, 000	215, 400, 000	208, 150, 000	165, 000, 000	201, 250, 000	185, 700, 000
Austria and Hungary..	190, 000, 000	152, 200, 000	101, 600, 000	124, 050, 000	90, 000, 000	71, 050, 000
Russia and Poland .. .	135, 000, 000	132, 500, 000	87, 500, 000	112, 500, 000	90, 000, 060	80, 000, 000
Belgium	55, 000, 000	43, 550, 000	37, 100, 000	31, 050, 000	39, 125, 000	41, 550, 000
Holland, Sweden, Italy, and other states of Europe not mentioned ....., ...	25, 000, 000	12, 500, 000	10, 000, 000	7, 500, 000	5, 000, 000	4, 000, 000

DE WITT C. SPRAGUE,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, October 9, 1871.

GERMANY—1871.

Insignificant quantities are imported of colonial sugar, and it becomes daily rarer in this country. Beet sugar has entirely removed the colonial sugar, and the former is alone used for general consumption. The beet sugar manufactories are increasing from year to year. Those of this city have produced 294,266 centners, and the rate of duty is 8 silbergroschen of 100 pounds raw beets.

GEO. HOLSCHER,
Consul.

BRUNSWICK, *October* 16, 1871.

GERMANY—1875.

REPORT BY CONSUL-GENERAL WEBSTER, OF FRANKFORT.

The sugar manufacture has now become a staple business in Germany. There are now 341 manufactories in Germany, more than one-half of which are in the Saxon provinces. In Würtemberg, 6; in Bavaria, 2; and Baden only 1. The manufacture of this article has grown from 100 establishments, making 124,000 centners, in 1842, to 341 establishments, making about 4,000,000 centners of sugar annually. In 9 months, from September 1 to June 1, 1875, 55,072,412 centners of beet sugar were raised in Germany, which pays a tax of about 18 cents per

centner, while during the same period in 1873–'74 more than 70,000,000 centners were raised, being a decrease of 20 per cent. In consequence of this extent of production in the last 10 years the consumption has so much increased that while for 30 years only five pounds of sugar to a person could be reckoned, now ten pounds can be reckoned annually. In addition to this, about 25 per cent. of the production is exported.

WILLIAM P. WEBSTER,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Frankfort-on-the-Main, November 10, 1875.

GERMANY—1878.

Of the agricultural products the sugar-beet continues to be a leading staple. The beet crop of the last and the immediately previous season is shown in the following exhibit:

Return of the beet-sugar production of the year from September 1, 1877, *to August* 31, 1878.

[GERMAN ZOLLVEREIN.]

Countries and districts.	Factories on Sept. 1—		Beets manufactured into sugar during the year ending Aug. 31—	
	1877.	1876.	1878.	1877.
I. Kingdom of Prussia:			*Cwt.*	*Cwt*
1. Province of West Prussia	1	1	243, 415	261, 570
2. Province of Brandenburg	17	18	2, 634, 350	1, 982, 325
3. Province of Pomerania	6	6	1, 225, 830	896, 810
4. Province of Posen	1	1	346, 250	325, 605
5. Province of Silesia	47	47	10, 740, 583	8, 417, 180
6. Province of Saxony with the principality of Schwarzburg	140	141	39, 134, 712	34, 100, 651
7. Province of Schleswig-Holstein	1	1	284, 540	264, 733
8. Province of Hanover	27	26	6, 264, 430	5, 566, 965
9. Province of Westphalia	2	1	128, 415	102, 360
10. Province of Hesse-Nassau	1	1	108, 400	93, 955
11. Rhine province	8	8	2, 382, 895	2, 699, 420
Total Prussia	251	251	63, 493, 820	54, 711, 574
II. Bavaria	2	2	292, 105	246, 000
III. Würtemberg	5	5	1, 064, 762	1, 058, 172
IV. Baden	1	1	895, 030	292, 721
V. Mecklenburg	2	1	411, 290	174, 936
VI. Thuringian States	5	5	1, 164, 542	978, 913
VII. Brunswick	29	29	6, 454, 089	6, 608, 620
VIII. Anhalt	33	32	8, 489, 540	7, 336, 995
IX. Luxemburg	2	2	142, 190	192, 800
Grand total	330	328	82, 407, 368	71, 000, 731

H. KREISMANN,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, November 30, 1878.

GERMANY—1878.

REPORTS BY CONSUL-GENERAL KREISMANN, OF BERLIN.

The quantity of beet taxed and used in the manufacture of sugar amounted in the harvest of September–August, 1876–'77, to 70,949,323 cwt., as against 83,225,683 cwt. in the preceding year, showing a decrease therefore of nearly 15 per cent. Along with this falling off in the yield there was a still greater decrease in the production in France and in the other countries, so that the prices toward the end of 1876 reached quite an extraordinary height, and the consumption of sugar experienced considerable reductions. The exports of German raw sugar have therefore in the last year attained dimensions never before reached. According to the returns of exports, which at present are submitted up to the end of August, the sugar trade and sugar consumption of Germany show the following results as compared with those of the preceding years:

Harvest.	Production of beet sugar.	Imports.	Exports.	Consumption.
	Cwt	*Cwt.*	*Cwt.*	*Cwt.*
1874–'75	5, 128. 547	568, 930	240, 250	5, 457, 927
1875–'76	7, 160, 964	426, 489	1, 147, 820	6, 439, 633
1876–'77	5, 800, 000	163, 900	1, 162, 620	4, 801, 300

Notwithstanding the diminished production, the export of beet sugar from Germany has yet experienced an increase, the home consumption on the other hand remaining behind that of the year 1875–'76 by about 1,600,000 cwt. With the simultaneous falling off in the beet sugar productions in France the home-sugar manufacturers have, however, been sufferers in a less degree than the state or rather the customs department. The increased demand of France and of England for foreign raw sugar gave the German manufacturers toward the end of last spring an opportunity to dispose of a large quantity of their stock at a pretty good profit and thus to equalize the decrease in production by higher prices. The state, however, in the last year has not only lost so much in duties on sugar as the production of sugar has diminished, but also in proportion as the exports have increased. The falling off in the production amounts to about 1,400,000 cwt., which would represent a duty of some 13,000,000 of marks. The sugar-beet crop of Europe is estimated as follows:

	1877–'78.	1876–'77.	1875–'76.
	Tons.	*Tons.*	*Tons.*
Germany	355, 000	291, 204	346, 645
France	325, 000	243, 295	450, 877
Russia and Poland	250, 000	250, 000	245, 000
Austria-Hungary	235, 000	205, 267	180, 140
Belgium	60, 000	44, 467	79, 795
Holland and others	25, 000	25, 000	30, 000
Total	1, 250, 000	1, 059, 233	1, 322, 45[illegible]

This branch of agriculture has experienced an enormous development within the last twenty-five years. In 1850 the number of raw-sugar factories was 184, and the mass of sugar beet manufactured into sugar 14,750,000 hundred-weight, whereas in the years 1874–'75 333 factories were in operation, using up more than 55,000,000 hundred-weight of beet sugar.

H. KREISSMANN,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, November 26, 1877.

GERMANY—1881.

REPORT BY CONSUL-GENERAL BREWER, OF BERLIN.

Concerning the beet-sugar industry, a few explanatory remarks may not be out of place. How much the influence is appreciated of the cultivation of sugar beets upon agriculture and national welfare may be seen from a few passages extracted from a very valuable treatise by Richard von Kaumann on sugar industry (published by L. Guttentag—D. Collin, Berlin), in which it is stated that—

It is an established fact that notwithstanding the extensive cultivation of sugar beets, no decrease in the yield of cereals has taken place, but has, on the contrary, augmented by double and treble the amount in the districts where sugar beets are planted, and that at those very places the production of meat is steadily increasing. The growth of sugar beets requires that the soil be tilled to a greater depth, thus adding to the thrift also of other plants to be cultivated later on the same soil. Besides, the remnants or waste left in the manufacture of beet sugar furnishes not only an excellent food for cattle, but also a fertilizing stuff, dispensing to a considerable extent with the use of artificial manure. But the profit is also considerable which this industry affords people who work in the sugar manufactories, as they get employment throughout the whole year, during the spring and summer seasons, in the growing and cultivation of the beets, and during the fall and winter in the manufactories.

Exhibit C is a statement showing the beet-sugar manufacture during the year ended August 31, 1881:

EXHIBIT C.—*Table showing the results of the beet sugar manufactured during the year from September* 1, 1880, *to August* 31, 1881.

[Quantities in 100 kilograms.]

States.	Factories in operation.	Beets worked.		
		Produced.	Purchased.	Total.
I. Prussia	256	14, 013, 154	11, 662, 010	25, 675, 164
II Bavaria	2	71, 650	72, 439	144, 089
III. Wurtemberg	5	194, 505	256, 944	451, 449
IV. Baden	1	62, 928	78, 862	141, 790
V. Mecklenburg	1	34, 087	130, 007	164, 094
VI. Thuringian States	4	272, 730	170, 000	442, 730
VII. Brunswick	30	2, 426, 957	835. 272	3, 262, 229
VIII. Anhalt	32	1, 685, 809	1, 086, 469	2, 772, 278
IX. Luxemburg	2	29, 000	54, 575	83, 575
Total	333	18, 790, 820	14, 346, 578	33, 137, 398
Equal to cwt	.....	41, 339, 804	31, 562, 471	72, 902, 275

EXHIBIT C.—*Table showing the results of the beet sugar manufactured, etc.*—Continued.

States.	Evaporated crystallizable juice.	Beets still to be worked.	Total production of beets.	In the preceding year.	
				Factories.	Quantity worked.
I. Prussia	3,112,939	22,029,712	47,704,876	251	37,407,890
II. Bavaria	18,574	104,787	248,876	2	206,600
III. Wurtemberg	49,975	365,040	816,489	5	868,663
IV. Baden	19,520	240,000	381,790	1	245,664
V. Mecklenburg	21,070	150,906	315,000	1	236,559
VI. Thuringian States	61,259	252,500	695,230	4	672,434
VII. Brunswick	371,555	2,201,631	5,463,860	30	4,572,613
VIII. Anhalt	318,469	2,440,318	5,212,596	32	3,763,804
IX. Luxemburg	10,356	32,000	115,575	2	78,388
Total	3,983,778	27,816,894	60,954,292	328	48,052,615
Equal to cwt	8,764,177	61,197,166	134,099,442	.....	105,715,753

Starch sugar was produced in the fiscal year ended March 31, 1881, by forty-five factories (against forty-four in the preceding year), converting 1,000,740 cwt. of wet starch and 25,198 cwt. of dry starch into 233,015 cwt. of solid starch sugar, 355,784 cwt. of starch-sugar sirup, and 16,924 cwt. of coloring for brandy, etc.

M. S. BREWER,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, November 12, 1881.

GERMANY—1883.

REPORT BY CONSUL KIEFER, OF STETTIN.

EXPORTS OF BEET SUGAR TO THE UNITED STATES.

I have the honor to report to you the establishment of a new beet-root sugar factory near Stettin, to be called Zuckerfabrik Schenne. Considering the importance this industry already has obtained (existing only since the beginning of this century), the constant and rapid increase of it from year to year, the material part it takes in augmenting national wealth, the new and remunerative employment it gives to thousands of men, particularly during winter time; the large profits it yields, as well to the farmer as to the manufacturer; the considerable amount of taxes it pays to the Government, and last but not least, the beginning of export of raw sugar to the United States—the home of the sugar cane—it may well be worth while to pay attention to a new enterprise of this kind in our close neighborhood.

THE INDUSTRY IN POMERANIA.

It is only a short time since the beet root has been introduced into Pomerania, the principal districts in Germany for its cultivation nearly exclusively having been the Prussian province of Saxony (Magdeburg

being especially known for it), Silesia, Hanover, Braunschweig, and Anhalt, these producing together 78 per cent. of the total production of crude sugar.

During the last 12 years some factories in Pomerania have been erected, which are paying a very liberal dividend—from 60 to 100 per cent.

ESTABLISHMENT OF A FACTORY IN STETTIN.

Towards the close of last year the project of establishing such a factory near Stettin was discussed; and the preliminaries all having been fulfilled, the organization of the company, Zuckerfabrik Schenne, took place January 28 of this year in this city.

According to the statutes, the capital stock will consist of 900 shares of 500 marks each, making a total of 450,000 marks, with power given to the board of directors to increase the capital to 750,000 marks eventually.

The shares are either beet-root shares, so called, or cash shares. There are 614 of the first kind, representing 107,000 marks, and 286 of the other class, representing 143,000 marks, all the shares having been subscribed for, and 10 per cent., as first payment, has already been paid in; only 10 per cent. more besides the first payment of 10 per cent. will be asked in cash of the shares, the so-called beet-root shares; the balance due of 80 per cent. will be compensated by a deduction of 20 pfennigs per centner of the roots, to be delivered. By this very ingenious plan, the company, as will be seen at once, secures at the same time capital and raw material at a reasonable price for running the factory.

The business of the company is managed by a board of directors and a board of trustees and the general meeting of the shareholders.

Each director must hold at least 30,000 marks in shares, which he has to deposit with the trustees as surety.

The total expenses for putting in running order are estimated at 797,937 marks, equalized by an income of 750,000 marks on shares and a mortgage to be given for 200,000 marks, leaving 152,063 marks for carrying on the business.

It seems to me that the whole plan has been well considered, is based on sound principles, and is resting upon a very solid foundation.

THE BEET-ROOT INDUSTRY OF THE EMPIRE.

In order to show the importance of this industry to our farmers and capitalists more clearly and conclusively, I inclose a report concerning the manufacture and taxation of beet sugar in Pomerania and the states belonging to the German customs for the year from August 1, 1882, to July 31, 1883, as also a calculation for 1883–'84, published by the Imperial Statistical Bureau, and reprinted in the New Stettiner Zeitung of January 26, 1884.

In perusing this report, of which the following is a synopsis, it appears that the possibility to export German sugar was shown first in the year 1860; that in consequence thereof for favoring and promoting it, the German Government refunded the taxes paid on sugar manufactured when exported, and as the tax was levied by an assessment on each centner of beets used and the drawback calculated according to the weight of sugar to be exported, it happened that gradually, in an indirect way, a premium was paid for sugar to be exported, viz: It was agreed and taken for granted that 12.5 centners of beet roots were needed for 1 centner of crude sugar; the centner of beet roots paid 80 pfennigs tax, and 9.40 pfennigs were returned for crude sugar to be exported; by improved methods of manufacture and better cultivation of the beet root itself, during the last 12 years only 11.39, and even in the last 2 years only 10.46 and 10.47 centners respectively of beets were needed for 1 centner of crude sugar, and so there was paid back on each centner of crude sugar a tax on 1.10 to 2.04 centners of beet roots which never had been paid for, being in fact equal to a premium paid on export. The consequence was that the manufacturers found it even more profitable to send their products abroad, and in 1881 we find from this consular district alone an export of crude sugar to the United States for $12,336; in 1882, for $127,818; and in 1883, for $78,746.81, which is expected to be increased during the next years.

In order to correct this state of things a commission on sugar tax was appointed early in 1883, which is in session yet, and reduced as a temporary measure the drawback 40 pfenning on each centner of sugar for 2 years.

During the time it is hoped the commission will have finished its labors and will have reached a final result.

The tax on beet-root sugar amounted in 1871–'72 to 36,014,691 marks; duty on imported sugar, 12,498,225; drawback on exported sugar, 3,875,916; net income, 44,637,000; in 1882–'83 beet-root tax, 139,954,448; import duty, 1,730,108; drawback paid, 73,507,595; total net income, 68,176,961 marks. To those taxes to be refunded must be added those that have not been actually paid out yet, being due only after 6 months, leaving in fact only a net income for 1882–'83 of 51,643,686 marks or 1 to 13 marks per head against 1 to 15 in 1871–'72.

The development of this industry in Pomerania during the last 12 years shows itself best by comparing the figures of 1871–'72 with those of 1882–'83.

Years.	Roots consumed.	Crude sugar manufactured.
	100 *kilos*.	100 *kilos*.
1871–'72	378, 223	32, 108
1882–'83	841, 245	72, 209

In addition has to be mentioned the Provincial Sugar Manufactory's refining establishment which increased the refining of raw beet-root sugar since 12 years continually and steadily from 105,203 double centners in 1871–'72 to 165,872 double centners in 1882–'83 without using any sugar-cane or colonial sugar during the whole time.

The total result of the fiscal year 1882–'83 shows an extraordinary increase of production compared with the last year's, caused partly by the establishment of new factories and the enlarging of those already existing, partly by cultivation of the beet root on a larger area, and principally by the unusually rich harvest of those roots.

There were 358 factories in operation, an increase of 15 compared with the preceding year, which produced 8,351,646 double centners of crude sugar against 5,997,222 the preceding year, and paid 139,954,448 marks taxes against 100,351,163 marks in 1881–'82. For the fiscal year 1883–'84 there will be in operation 373 factories, another increase of 15 over 1882–'83.

The revolution which has taken place since 12 years in the German sugar industry becomes most apparent by comparing the principal dates of 1871–'72 with those of 1882–'83.

Quantity of roots raised, from 22,509,182 and 87,471,537 100-kilograms.

Quantity of crude sugar produced, 1,864,419 and 8,351,646 100-kilograms.

Quantity of roots needed for producing 1 kilograms crude sugar decreased from 12.07 kilograms to 10.47 kilograms.

The import of all kinds of sugar tumbled down to 66,012 from 496,332 (100 kilos); the export increased from 142,757 100-kilograms to 4,725,514 100-kilograms, and the home consumption from 5.5 to 8.1 kilograms for every single inhabitant.

THE BEET-ROOT INDUSTRY IN THE UNITED STATES.

If I look at these astonishing results I can not help thinking that in the cultivation of this root a new and large field of enterprise and prosperity would be given to our American people, and the object of this dispatch is to call the attention of those whom it may concern to this very important matter.

Climate and soil in many States, as for instance, in Michigan, Wisconsin, Iowa, Minnesota, are particularly fitted for the culture of sugar beet, and 100,000 acres lying idle now, if planted with it would yield a rich harvest; thousands of men would get work in the factories needed for gaining the sweet juice, and for manufacturing the sugar; the genius of the American people would contrive without doubt in a short time new machines and processes to make this wonderful industry even more profitable than it is in Germany; the time will come when the beet root will be for the North what the sugar-cane is for the South, and sugar factories replace within the Northern States the cot-

ton mills now springing up in the South, and the wealth of the nation will be increased materially, not only by adding a new industry to the country, but also by saving hundreds of thousands of dollars now annually sent abroad.

HERMANN KIEFER,
Consul.

UNITED STATES CONSULATE,
Stettin, February 2, 1884.

GERMANY—1884.

REPORT BY CONSUL-GENERAL VOGELER, OF FRANKFORT.

The sugar industry enjoys the special care and protection of the German Government. In my former reports I have already mentioned the fact that the climate of Germany is thought to be specially adapted to the culture of the sugar beet, being sufficiently temperate and moist to insure, if not always an abundant, at least a never-failing crop. The cheapness of labor, moreover, makes the cultivation of the sugar beet profitable to the farmer so long as he can secure anything above 1 mark (24 cents) for 1 cwt. of beets. The Government, therefore, in order to stimulate this branch of agriculture and the industry connected therewith, not only refunds to the exporter of raw sugar the amount of tax paid, but something beyond this; in other words, it puts a premium on the exportation of raw sugar. This result is brought about in the following manner:

The Government assumes, I will say, that it requires 11 cwt. of beets to produce 1 cwt. of sugar. At this assumed rate, which the Government at the time the rate was fixed knew to be a liberal one, the tax is levied. By improved methods and machinery, however, the manufacturer is now enabled to gain 1 cwt. of sugar from about 9 cwt. of beets, and being refunded in case of exportation at the rate mentioned above, he is actually paid a premium on the sugar exported. This premium being paid out of the general fund obtained by taxing the beets consumed, it follows that as the exports increase the revenues derived from the sugar-beet tax must decrease. This, indeed, is the actual fact. But now here is the dilemma in which Government finds itself at the present moment: The unusual protection afforded to the sugar industry has so unnaturally stimulated that industry as to cause factories to spring up like mushrooms all over Germany. Most of these factories are large establishments, built at a cost of from $50,000 to $300,000, employing expensive machinery and a great force of chemists, engineers, office men, and laborers. In the fall of 1881 there were in operation 338 of such establishments; in the fall of 1882, 352; 1883, 364, and 1884, 390.

It is estimated that the number of factories now completed and soon to be completed amounts to nearly 500. Besides, the capacity of many of the factories which were in operation during the last 3 years has

been greatly increased. The dividends paid up to the year 1883 in many cases reached 40 per cent. per annum, while 15 to 25 per cent. was not considered an unusual result. Under such circumstances overproduction and a consequent collapse were inevitable. It has come within the last year, and the stagnation is universal. The Government hesitates to remove the stimulus referred to, fearing still further to depress the market, and yet without a change of the law the present condition of things will only be continued. The effect of this overproduction has been startling, and the end is not yet. Raw sugar has declined in price at the following rate, viz:

Date.	Cost of 100 pounds of raw sugar.
October, 1881	$6.84
October, 1882	6.65
October, 1883	6.25
April, 1884	5.47
July, 1884	5.14
October, 1884	4.42

Most of the factories had hitherto paid 1.25 to 1.30 marks per cwt. of beets; now those which are believed to be in the best condition pay about 75 pfennigs (18 cents) per cwt., while most of them offer only 60 pfennigs (15 cents) per cwt.; some, of course, have closed up altogether. This decline in the price paid for beets again is a hardship to the farmer, the greatness of which will become apparent when it is considered that the amount of sugar beets consumed during the year ended August, 1883, amounted to more than 193,000,000 cwt., and that the amount produced this year can not fall much below 250,000,000 cwt.

The decline of this great industry, together with the low prices of grain, have had a very depressing influence on trade generally, and it is therefore safe to say that the condition of Germany as to trade and commerce is at the present moment anything but encouraging.

FERDINAND VOGELER,
Consul-General.

UNITED STATES CONSULATE GENERAL,
Frankfort, January 31, 1885.

GERMANY—1885.

REPORT VICE-CONSUL DITTMAR, OF STETTIN.

The duty on beet roots raised in this country shows a revenue in 1885 as follows:

Items.	1885.	1884.
	Marks.	*Marks.*
Revenue	160, 581, 112	157, 031, 971
Less drawback	125, 949, 562	109, 704, 580
Net	34, 631, 550	47, 327, 391

During the season—from the fall of 1885 to the end of February, 1886—duty was paid for 7,063,828 tons, of 1,000 kilograms, of beet roots, against 9,961,966 tons during the same time in 1884–'85.

The smaller crop of beet roots during the last campaign proves a pretty large decrease in their cultivation, caused by the low prices of sugar, which in their turn pressed upon those of the beet roots to such an extent that growing them did not pay the farmer any longer.

On the other hand, there is no doubt the improvement in the way of extracting sugar from the molasses by the "strontionit" process will have increased the percentage of sugar extracted from the beet roots. The export of beet-root raw sugar from the whole of Germany in the year 1885 amounted to 529,547 tons, against 738,629 tons, of 1,000 kilograms, in 1884, of which Stettin exported by sea, in 1885, 45,069 tons, value 45,000,000 marks, of raw sugars of at least 88 per cent. polarization, against 27,742 tons in 1884, and 18,690 tons, value 10,000,000 marks, of refined sugars, against 22,368 tons, in 1884, of which quantities 3,493 tons of raw sugars were sent to the United States in 1885, against 3,029 tons in 1884.

The abundant crop of beet-root in 1884 influenced the prices of sugar still in 1885, and they did not look up before a considerable decrease of its cultivation in 1885 was evident. The rather high prices quoted in May and June were but nominal, as hardly any business was done at that time, the prices of refined sugars not looking up proportionately, and but very small quantities being bought for exportation. For 50 kilograms of refined sugar of 96 per cent. polarization 20.60 marks were paid here in January, 22 marks in February, 23 marks in April, 26.60 to 27 marks in May and June, 25.80 marks in July and August, 25 marks in September, 24 marks in October and November, and 25 marks in December.

During the whole year the business in refined sugars was languid, and prices were low in proportion to those paid for raw sugars. The refined sugars extracted by the "Strontionit" process from molasses proved a strong competitor to the products of the refineries, and most probably there will be no fair balance in prices before, by the increase of molasses refineries, the price of molasses has been raised to a right proportion with those of the raw sugars. Twenty-four thousand four hundred and eighty-two tons (at 1,000 kilograms to the ton) of molasses, value 2,500,000 marks, were exported from here by sea, the greater part of which was forwarded to France, and besides which were 8,460 tons of potato sugar, potato sirup, starch sugar, starch sirup, and glucose, value 1,700,000 marks.

JULIUS DITTMAR,
Vice-Consul.

UNITED STATES CONSULATE,
Stettin, September 25, 1886.

GERMANY—1886.

REPORT OF CONSUL-GENERAL RAINE, OF BERLIN.

By an act approved June 1, 1886, relating to sugar taxation, a new classification of sugar and a new method of collecting tax on beet sugar (equaling a reduction of export bounties) was introduced.

Section 1 provides that beet-sugar tax of raw beets for manufacturing them into sugar shall be collected at a rate of 1.70 marks (40 cents) per 100 kilograms.

Section 2 provides that for sugar either exported or warehoused in bonded warehouses or private transit storehouses, provided that such quantity warehoused is not less than 500 kilograms, a bounty shall be granted at the following rates per 100 kilograms:

Kind of sugar upon which bounty is paid.	Amount.	Equivalent in United States money.
	Marks.	
(*a*) For raw sugar of at least 90 per cent. polarization and for refined sugar of at least 90, but not exceeding 98 per cent. polarization:		
(1) From August 1, 1886, to September 30, 1887	18.00	$4.28
(2) From October 1, 1887	17.25	4.16
(*b*) For candy and for sugar in white, full, hard loaves, lumps, tablets, cubes, &c., of at least 99½ per cent. polarization:		
(1) For the former period	22.20	5.28
(2) For the latter period	21.50	5.11
(*c*) All other hard sugar, not otherwise provided for, as well as for all white dry sugar (containing no more than 1 per cent. water) in crystals, also pulverized, &c., of at least 98 per cent. polarization:		
(1) For the former period	20.80	4.95
(2) For the latter period	20.15	4.80

Section 3 gives owners of beet-sugar works—for the payment of the tax due on manufactured beets, upon security—a credit for a term (as a rule, to be prescribed) not exceeding 6 months.

This legislative measure, especially dictated by the fact that the revenues from sugar showed a very palpable deficiency, appears rather late, and, as is claimed, should have been resorted to when this industry was in a flourishing state.

Beet-sugar production in the German Zollverein, years 1880–'81 to 1884–'85.

[Ton = 22 cwt. Pound = ½ kilogram. 100 kilograms = 2.2 cwt.]

Year.	Factories in operation.	Factories obtaining juice by—		Beets worked.	Produced by the factories.		Quantities obtained.		
		Diffusion.	Pressing, centrifugal filter maceration.				Filling mass.	Raw-sugar products of all kinds.	Molasses.
				Tons.	*Tons.*	*On acres.*	*Tons.*	*Tons.*	*Tons.*
1880–'81	333	309	24	6,322,203	3,871,679	296,077	739,336	555,915	164,984
1881–'82	343	324	19	6,271,948	3,431,754	303,140	774,004	599,722	150,813
1882–'83	358	343	5	8,747,154	4,448,632	323,135	1,097,508	835,165	196,305
1883–'84	376	368	8	8,918,130	4,205,064	352,107	1,216,879	940,109	207,978
1884–'85	408	402	6	10,402,688	4,936,246	370,690	1,448,619	1,123,030	259,700

Beet-sugar production in the German Zollverein, years 1880–81 to 1884–'85—Continued.

Year.	Obtained from 100 kilograms of taxed beets.			Obtained from 100 kilograms.		Quantities of beets required to obtain 1 kilogram (=2.2 pounds) of raw sugar.
	Filling-mass.	From the filling-mass.		Raw sugar.	Molasses.	
		Raw sugar.	Molasses.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1880–'81	25.71	19.35	5.72	165.41	49.10	25.01
1881–'82	27.14	21.03	5.23	170.45	42.85	23.01
1882–'83	27.61	21.01	4.92	167.42	39.35	23.03
1883–'84	27.30	21.08	4.66	154.50	34.18	18.98
1884–'85	30.64	23.73	5.50	170.54	39.44	20.37

FRED. RAINE,
Consul-General.

UNITED STATES CONSULATE,
Berlin, January 10, 1887.

GERMANY—1885.

REPORT BY COMMERCIAL AGENT SMITH, OF MAYENCE.

In various commodities attempts were made during the year to keep prices up by means of combinations and by a lessening of production, and notably was this the case with respect to sugar, which experienced a marked benefit therefrom. Hops, copper, silver, cotton, fats, and quinine were marked by decided declines. Raw silk has been very low in price, lower almost than ever before, but in the latter part of the year, after a long period of stagnation, an improvement in price took place.

While there was no brilliant improvement in the sugar market, business in sugar has been more favorable than in 1884, when there was a crisis in the industry. A limitation of production in this article has, of course, had a somewhat unfavorable effect upon the railroads engaged in the transportation of beets, sugar, and coal, and diminished their receipts. The imperial bureau of statistics at Berlin gives the following as a review of the results of the sugar "kampagne," as it is termed, of 1885–'86. A kampagne is the period from August to August, from one crop to another. According thereto, there were in operation up to December 1, 1885, some 399 sugar factories, which, up to that date, had used 50,905,541 double centners* of roots. From this quantity of roots, that gave a product of 7,134,920 double centners, 28,676.906 double centners were grown by the manufacturers themselves, and 22,228,635 double centners were purchased. It is conjectured that this kampagne

*220.10 pounds avoirdupois.

19,821,623 double centners of roots remain to be worked up, which would make a total quantity of 70,727,164 for the entire kampagne, against 104,026,883 double centners for the kampagne of 1884–'85, or 32 per cent. less. This, however, is only a preliminary estimate, which can be a good deal changed before the end of the kampagne.

The industry being now on a somewhat healthier basis than it has been for some time, the Imperial Government judges that the opportunity is a fitting one for a revision and reform of the tax and drawback on sugar, which has long been demanded. Beet sugar is now subjected to taxation, as far as I understand it, in the following way: Under a law enacted in 1869 a tax of 80 pfennigs up to recently has been imposed upon each centner of beet roots to be converted into sugar by the sugar manufacturers, and when the crude sugar was exported a drawback of 9.40 pfennigs was returned, based upon the calculation that 12.5 centners of beet roots were required to produce 1 centner of crude sugar; but as improved methods of obtaining the sugar were introduced, by which the beets were made to render greater returns, about 10½ centners of roots only being requisite to yield a centner of raw sugar, the Government in allowing a drawback of 9 marks 40 pfennigs paid on each centner of crude sugar sent out of the Empire, a presumed tax on 1 to 2 centners of beets, which had never really been paid, thus paying, as it were, a premium on export. It is now proposed to remedy this state of things to a certain extent by the following measure, which has been submitted to the Reichstag at its present session, but which has not been acted upon. The law of June 26, 1869, is to be replaced on August 1, 1886, by the following provisions: From August 1, 1886, to July 31, 1887, a tax of 1.70 marks on each double centner (85 pfennigs per centner) of raw beets to be levied, and from August 1, 1887, onward 1.80 marks per double centner. On exported raw sugars of at least 90 per cent. polarization the following drawbacks are to be allowed:

(*a*) On refined sugar of not more than 98 per cent., from August 1, 1886, to September 30, 1887, a drawback of 18 marks for each double centner when the quantity amounts to at least 5 double centners; from October 1, 1887, onward 18 marks 20 pfennigs on each double centner.

(*b*) On candies and on sugar in white, full, hard blocks, cakes, or sticks, or made small in the presence of the officials, for the time from August 1, 1886, to October 31, 1887, 22.40 marks.

(*c*) For all other hard sugars, as well as for all white dry sugar (not containing more than 1 per cent. of water) in crystal, crumbled, or powdered form, of at least 98 per cent. polarization: (I) for the time from August 1, 1886, to October 31, 1887, a drawback of 20 marks 80 pfennigs; (II) for the time from November 1, 1887, onwards, 21 marks.

It is estimated by the Government that the number of double centners of beets annually used for making sugar will be 90,000,000, upon which a tax of 1.80 marks is to be levied, which would give a total tax

of 162,000,000 marks ($38,556,000). From this quantity of roots it is considered that 8,571,429 double centners of raw sugar, with a polarization of 93.75 per cent. will be obtained.

The domestic consumption is put at 3,500,000 double centners. There thus remains 5,071,429 double centners for exportation, which, with a drawback of 18.20 marks, will make a sum amounting to 82,300,000.80 ($19,587,000) to be deducted from the entire tax, thus leaving an income accruing to the Government of 69,699,992.20 marks ($16,588,598.14); after deducting the 4 per cent. administration costs of 6,480,000 marks, 68,219,992.20 marks would pass into the Imperial treasury; but the cultivation of the beet is constantly increasing, and in proportion as the quantity exported is greater in ratio to the amount consumed in the Empire will the receipts of the Government be less.

J. H. SMITH,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Mayence, January 8, 1886.

GERMANY—1885.

REPORT BY CONSUL-GENERAL MUELLER, OF FRANKFORT-ON-THE-MAIN.

That the extent of the sugar industry has, like many other industries, reached its limits, will appear from some figures here given. Within the last six years the number of sugar factories went up from 328 in 1879–'80 to about 408 in 1885, and, as will appear from the inclosed Exhibit O, the quantity of sugar increased from 409,415 tons in 1879–'80 to 940,109 tons in 1883–'84.

The decline of sugar prices is explained by this enormous increase of production.

While on an average raw sugar in 1883 was still quoted at 57.19 marks per 100 kilograms, it sold in:

Date.	Per 100 kilograms.	Date.	Per 100 kilograms.
	Marks.		*Marks.*
January, 1884	54.00	July, 1884	47.10
February, 1884	53.56	August, 1884	46.03
March, 1884	52.52	September, 1884	42.00
April, 1884	50.07	October, 1884	37.40
May, 1884	48.76	November, 1884	38.10
June, 1884	49.07	December, 1884	35.10

The steady tendency towards a decline of prices induced large manufacturers of Madgeburg and neighboring places to form a "ring" for the purpose of fictitiously determining the extent of production and the price of sugar. It seems that owing to this rather compulsory measure sugar was quoted in August, 1885, at 47.80. It is doubted, however, whether they will be able to force prices of sugar, particularly in view

of the fact that their working capital, for the present at least, does not exceed 1,000,000 marks.

The German Government levies on unmanufactured beets a tax of 1.60 marks per 100 kilograms, while it pays a bounty on beet sugar exported:

	Marks.
(*a*) On raw sugar of at least 88 per cent polarization	18.80
(*b*) For candies and for sugar in full white hard loaves, of about 12.5 kilograms net weight, or if reduced to small pieces in the presence of the custom officers, per 100 kilograms, net weight	2.22
(*c*) For all other kinds of hard sugar, as well as for all white dry sugar of at least 98 per cent polarization	20.80

The present system of taxation and bounties is, however, much objected to, and a bill is to be submitted to the Reichstag to regulate the matter on a different basis.

It will appear from the following exhibit that in the fiscal year 1883–'84 the net proceeds from all taxes and duties on sugar collected by the German Zollverein amounted to $11,374,000, taxes collected on unmanufactured beets amounted to $33,960,000, and duties to $330,000; total, $34,293,000; bounties and drawbacks, $22,919,000; leaving net revenue, $11,374,000.

Beet-sugar production in the German Zollverein.

[Ton = 22 cwt. Pound = ½ kilogram.]

Year.	Factories in operation.	Factories which obtained the juice by—		Beets worked.	Beets produced by the factories.		Quantities obtained.		
		Diffusion.	Pressing, centrifugal filter, maceration.				Filling mass.	Raw-sugar products of all kinds.	Molasses.
				Tons.	*Tons.*	*On acres.*	*Tons.*	*Tons.*	*Tons.*
1879–'80	328	291	37	4,805,262	2,850,586	282,507	554,409	409,415	131,371
1880–'81	333	309	24	6,322,203	3,871,679	296,077	739,336	555,915	164,984
1881–'82	343	324	19	6,271,948	3,431,754	303,140	774,004	599,722	150,813
1882–'83	358	343	5	8,747,154	4,448,632	323,155	1,097,508	835,165	196,305
1883–'84	376	368	8	8,918,130	4,205,064	352,107	1,216,879	940,109	207,978

Year.	From 100 kg. (=2.2 cwt.) of taxed beets there were obtained—			From 100 kg. (=2.2 cwt.) were obtained—		To obtain 1 kg. (=2.2 lbs.) raw sugar, quantities of beets were required.
	Filling mass.	From the filling mass.		Raw sugar.	Molasses.	
		Raw sugar.	Molasses.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1879–'80	25.38	18.74	6.00	162.47	52.14	25.82
1880–'81	25.71	19.35	5.72	165.41	49.10	25.01
1881–'82	27.14	21.03	5.28	170.45	42.85	23.01
1882–'83	27.61	21.01	4.92	167.42	39.35	23.03
1883–'84	27.30	21.08	4.66	151.50	34.18	18.98

JACOB MUELLER,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Frankfort, November 30, 1885.

GERMANY—1887.

REPORT BY CONSUL WAMNER, OF COLOGNE.

To raise the price of sugar beet in Germany, which had sunk so low that the producers could scarcely realize any profit whatever in raising beets, the cultivation in the year 1885 was limited in as great a degree as possible. However, in 1886 the cultivation was again increased, when it was conjectured that the stagnation in the sugar market would soon be relieved; and besides it was a settled conviction that the cultivation of beet root as compared with other crops offered a more certain and profitable return. Large transactions in "futures" were entered into at high prices, which likewise stimulated and contributed to the increased cultivation. The crop of 1886 was a middling one, but it is generally acknowledged that the beets never before yielded so much sugar. The seed was sown in April, in warm, dry weather, and the cool and rather moist temperature of May materially aided the growth, and the hot spell from July up to September was most favorable towards the formation of sugar-producing elements in the beets. Thus the crops were gathered in an excellent condition—a condition which was due in the first place to the very favorable season, and secondly to a careful selection of the seed and the manures.

The beets were sold mostly by their bulk weight, and only in exceptional cases were the prices regulated according to the percentage of sugar. Prices varied from 1.30 to 2.50 marks (generally 1.50 to 1.80 marks) per 100 kilograms, being a slight advance on the prices which obtained in the previous campaign.

The improvements made in the campaign year 1886–'87 in the technical working in the manufacture of beet sugar were mainly in the direction of simplifying the separation and purifying processes, as also in the saving of material and work. Especially the treatment of the juice with sulphuric acid found great use, and improved methods of filtration were more frequently adopted, while the use of bone coal has been almost given up. In the campaign year 1886–'87, 137 factories (against 162 in the preceding campaign) prepared from molasses sugar, of which 55 worked with the *osmose* process. But in consequence of the low price of sugar and the proportionate high cost of molasses this process has not found use by a number of the factories supplied with the required apparatus, on account of its not being sufficiently remunerative. In 1885–'86, 78 factories worked with the osmose process, 79 in 1884–'85, 115 in 1883–'84, 124 in 1882–'83, and 135 in 1881–'82; by the elutions process of making sugar from molasses, 46 factories were occupied in 1886–'87, 51 in 1884–'85, 46 in 1883–'84, 50 in 1882–'83, and 44 in 1881–'82; by the substitution process, 10 in 1886–'87, 10 in 1885–'86 and 1884–'85, 13 in 1883–'84, 8 in 1882–'83, and 4 in 1881–'82; by the precipitation process, 2 in 1886–'87, 4 in 1885–'86, 5 in 1884–'85, 4 in 1883–'84, 6 in 1882–'83, and 4 in 1881–'82; by the elimination process,

17 in 1886–'87, 16 in 1885–'86, 13 in 1884–'85, and 2 in 1882–'83; by the strontium process, 4 in 1886–'87.

According to an estimate the following quantities of molasses were worked by the different processes by the above-mentioned factories during the campaign years 1886–'87:

	Kilograms.
By the osmose process	470,962
By the elution process	850,811
By the substitution process	116,766
By the separation process	323,065
By the strontium process	64,428
Other processes	9,098
Total	1,837,130

The following table shows the number of factories in the German Empire, the different methods employed for extracting the juice, and the quantity of beets worked during the campaign years 1871–'72 to 1886–'87 inclusive:

Campaign years.	No. of factories.	No. extracting by—			Beets worked.
		Diffusion.	Press process.	Other processes.	
					Tons.
1871–'72	311	52	216	43	225,091
1872–'73	324	63	220	41	318,155
1873–'74	337	80	214	43	352,876
1874–'75	333	113	181	39	275,674
1875–'76	332	157	137	38	416,128
1876–'77	328	197	98	33	355,003
1877–'78	329	224	81	24	409,096
1878–'79	324	258	50	16	462,874
1879–'80	328	291	28	9	480,526
1880–'81	333	309	20	4	632,220
1881–'82	343	324	16	3	627,194
1882–'83	358	343	12	3	874,715
1883–'84	376	368	6	2	891,813
1884–'85	408	402	4	2	1,040,268
1885–'86	399	395	3	1	707,031
1886–'87	401	397	3	1	830,167

The production, imports, and exports of raw sugar for the campaign years 1871–'72 to 1886–'87, inclusive, were as follows:

Campaign year.	Production.	Imports of refined and raw sugar, No. 19 and upwards.	Imports of raw sugar below No. 19.	Exports of raw sugar.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1871–'72	18,644	1,273	3,158	566
1872–'73	26,255	1,248	975	817
1873–'74	29,101	1,614	841	1,180
1874–'75	25,641	1,410	891	288
1875–'76	35,804	1,452	245	4,589
1876–'77	28,942	770	101	4,621
1877–'78	37,800	491	116	7,120
1878–'79	42,615	390	153	10,347
1879–'80	40,941	298	167	9,516
1880–'81	55,591	226	126	22,144
1881–'82	59,972	220	150	25,393
1882–'83	83,199	210	237	39,070
1883–'84	94,010	155	187	49,117
1884–'85	112,303	126	206	55,379
1885–'86	80,810	123	262	40,407
1886–'87	98,562	146	156	48,968

SELECTION OF THE SEED.

Taking the varieties in the same order as below given, the following are the results of the experiments:

Varieties.	Density, Brix.	Per cent. of sugar.	Quotient of purity.	Product per morgen.*
East Prussian	18.8	18.86	19.35	161.64
Knauer's Mangold II	19.1	16.82	87.78	171.72
Dippe's Sugar Richest	18.8	16.57	88.16	154.08
Knauer's Mangold I	18.4	16.40	89.00	212.94
Knauer's Improved Imperial (white)	18.7	16.38	87.63	186.84
Dippe's Improved Imperial	18.5	16.24	87.63	184.13
Knauer's Improved Imperial (rose)	18.2	15.95	87.51	176.58
Kl. Wanzleben Original	17.8	15.47	86.90	195.12
Knauer's Electoral	17.2	14.99	87.75	220.68
Aumühle	17.2	14.94	87.02	238.32
Mährisch	17.2	14.89	86.86	235.08
Koenigsberg.	17.2	14.88	86.48	252.72
Knauer's Imperial	17.3	14.78	85.56	247.26
Factory Seed	17.1	14.78	86.73	267.12
Knauer's	16.9	14.74	86.94	225.00
Heucke's	16.6	14.18	85.07	267.89

* Morgen = $\frac{63}{100}$ of an acre.

Grossman reports the following results of a series of experiments carried out in 1886 with different kinds of beets:

There were 16 different kinds of beets selected for the experiments, namely: East Prussian, Knauer's Mangold II, Dippe's Sugar Richest, Knauer's Mangold I, Knauer's Improved Imperial (white), Dippe's Improved Imperial, Knauer's Improved Imperial (rose), Kl. Wanzleben Original, Knauer's Electoral, Aumühle, Mährisch, Koenigsberg, Knauer's Imperial, Factory Seed, Knauer's, Heucke's Seed.

In latter years great care and attention have been given in Germany to the selection of the best beet seed. Professor Maercker, director of the agricultural experiment station at Halle, Province of Saxony, conducted in recent years a series of experiments with a variety of seed. The seed selected consisted of 26 different sorts, which were divided among 21 different experts for experiments. The following are the results obtained:

Denomination of seed.	100 lbs. beets per German morgen.*	Per cent. of sugar in beets.	Per cent. of sugar in the juice.	Quotient of purity.	100 lbs. sugar per German morgen.
A. *Sugar beet. Vilmorin race.*					
	148.8	16.28	17.86	86.2	24.24
Gebr. Dippe's improved best white quality	157.7	15.59	17.05	85.5	24.19
Vilmorin blanche améliorée, original					
Grosshoff (Quedlinburg), Vilmorin, second raising	177.0	14.89	16.04	84.7	26.29
Schäper (Rossla), Barbarossa, second raising	144.5	15.93	17.39	85.8	23.12
Schreiber & Son (Heringen), Vilmorin	141.4	15.39	16.91	85.1	21.83
Schlitte & Co. (Aumühle), Vilmorin, second raising	147.2	16.45	17.77	87.6	24.30
Hornung & Co. (Frankenhausen), Vilmorin, second raising	152.8	15.93	17.47	86.7	24.56
Sugar manufactory, Körbisdorf, Vilmorin, second raising	163.9	16.06	17.39	85.6	26.29

* Morgen = $\frac{63}{100}$ of an acre.

Denomination of seed.	100 lbs. beets per German morgen.*	Per cent. of sugar in beets.	Per cent. of sugar in the juice.	Quotient of purity.	100 lbs. sugar per German morgen.
B. *Sugar beet. Kl. Wanzleben race.*					
Kl. Wanzleben, original, old raising	201.6	14.74	16.00	85.8	29.78
Kl. Wanzleben, original, new raising	189.4	15.38	16.39	86.6	29.10
Dippe's improved Kl. Wanzleben, best	183.4	16.16	17.51	87.3	29.55
Grosshoff (Quedlinburg), Kl. Wanzleben	179.0	14.29	15.36	84.2	25.55
Braune (Biendorf) improved, Kl. Wanzleben	201.5	14.75	15.84	85.9	29.57
Schreiber & Son (Heringen), Kl. Wanzleben	205.3	14.89	15.96	86.0	30.86
Schlitte & Co. (Aumühle), improved, Kl. Wanzleben	184.9	15.71	17.02	86.4	29.08
Wilke (Gr. Möhringen), Altmärker, Kl. Wanzleben	209.5	14.34	16.05	84.4	30.09
Hornung & Co. (Frankenhausen), Kl. Wanzleben	166.2	15.40	16.93	86.7	25.82
Rabbethge (Einbeck), Kl. Wanzleben	183.1	15.21	16.17	85.5	27.72
Weinschenk (Lulkau), Kl. Wanzleben	196.2	14.84	15.76	86.2	29.32
C. *Vilmorin and Kl. Wanzleben. Cross.*					
Braune (Biendorf), Vilmorin and Kl. Wanzleben, cross	197.9	15.28	16.35	86.1	30.06
Strandes (Zehringen), Vilmorin and Kl. Wanzleben, cross	164.4	14.79	16.07	84.9	24.55
Bibrans (Uefingen), Vilmorin and Kl. Wanzleben, cross	174.4	13.81	14.92	83.5	24.01
D. *Various.*					
Vilmorin collet rose, original	204.2	14.74	14.60	84.4	28.03
Gebr. Mette (Quedlinburg)	198.1	14.98	16.30	86.9	29.66
Gebr. Mette (Quedlinburg), improved white imperial	185.0	14.61	15.78	84.7	27.02
Strandes (Zehringen), improved smooth leaf	193.3	14.29	15.44	83.6	27.29

*Morgen = $\frac{63}{100}$ of an acre.

The field on which the experiments were made, being a good second-class humus beet soil, with a loamy and marly subsoil, had been manured in the early part of spring with factory compost, rich in lime. A few days previous to planting the soil had been supplied with 100 pounds each of Chili saltpeter and nitrogenous phosphatic meal to the acre.

The question of manuring the soil is one that requires the greatest attention in the cultivation of the sugar beet. Careless and injudicious use of manures is more or less detrimental to the quality of the beet. In order to determine upon the quality and quantity of manures to be used it is necessary to possess a general knowledge of the physical character and chemical composition of the soil and the beets. The prejudice against the use of certain kinds of manures—such, for example, as saltpeter—seems to be unjust. But its abuse is detrimental, and therefore great care should be exercised in employing it. With reference to the question whether the percentage of sugar in the beets is determined by saltpeter manuring, the eminent Professor Wagner, of Darmstadt, makes the following observations:

If it has been formerly observed that by strong saltpeter manuring, notwithstanding that the same had been done in conjunction with phosphoric acid manuring, the amount of sugar in the beets showed a decrease of from $\frac{1}{2}$ to 1 per cent. or more, with a considerable reduction in the quotient of purity, the latest experiences furnish the

satisfactory result that beet cultivators have succeeded in establishing more uniformity in the percentage of sugar in the various kinds of beets, which is not at all, or only very slightly, diminished by manuring with 200 pounds of Chile saltpeter per morgen. A great number of experiments have proved that by strong saltpeter manuring a considerable increase in the crops of beet was obtained without showing any important reduction either in the percentage of sugar or quotient of purity in the juice. But to obtain such favorable results the chief conditions to be observed are the following:

1. Cultivate excellent sugar-rich varieties of beets.
2. Procure the seed from the best and most reliable quarter.
3. Use with Chile saltpeter a sufficient quantity of phosphoric acid, in order that the ripening of the beets is not retarded.
4. Apply the saltpeter before the sowing of the seed, and do not use it as a top dressing.

The following results were obtained from a series of manurial experiments carried out under the supervision of the agricultural society on the light and dark beet soils of the province of Posen, which show the average increase per 100 pounds of beets in the crop:

	Average increase.
200 pounds superphosphate	7.8
200 pounds superphosphate and 100 pounds Chile saltpeter	27.3
200 pounds superphosphate and 200 pounds Chile saltpeter	37.6
100 pounds superphosphate and 200 pounds Chili saltpetre	28.0
200 pounds Chile saltpeter	17.2
200 pounds ammoniated superphosphate	5.3

A mere glance at the above figures will serve to illustrate the rapid growth of the beet-sugar industry in Germany during the last 15 years. In the campaign year of 1871–'72 the production of raw sugar was only 18,644 tons, while in that of 1884–'85 it reached the enormous amount of 112,303 tons, showing an increase in 12 years of about 500 per cent.

UNITED STATES CONSULATE,
Cologne, March 17, 1888.

WM. D. WAMER,
Consul.

GERMANY—1887.

REPORT OF CONSUL MILLAR, OF LEIPSIC.

BOUNTIES.

A short time ago the Leipziger Zeitung, which is an official organ of the Saxon Government, published an article on the above subject with reference to the general question of bounties and the limits within which they should be confined. As the subject is in itself one of considerable importance, and is now occupying the attention of the Imperial Government, I have thought it worth while to summarize the arguments and conclusions of the article.

The duties of the Imperial Government are defined by the writer as twofold: First, to see that an important and wealthy industry, such

as the sugar fabrication, contributes its due share towards the taxes of the country; second, to protect the industry from the ruinous effects of French and Austrian competition, which would otherwise bring disaster upon those districts of Germany which depend upon the continuance of the sugar industry for their prosperity. The mean between these two functions, however, is no longer maintained. Last year 8,500,000 cwt. of sugar were consumed, on which a tax of 9 marks per cwt., amounting to about 76,000,000 marks, was levied. But of this sum only about 33,000,000 will remain in the treasury, the surplus of 43,000,000 returning as bounty into the pockets of the exporting manufacturers and refiners, to enable them to undersell their French and Austrian competitors in foreign markets. A similar state of things exists in Austria and France, in which latter country the bounty threatens in the course of a few years to consume the entire income derived from the duty. Obviously this state of things can not continue, and the Governments of all three countries have been compelled to devote their attention to the question.

The remedy, in the view of the writer of the article, is to be found by limiting the influence of protective duties. Such duties should confine themselves to securing the home market for the native producer; they should not attempt to secure for him the control of foreign markets. An industry which desires to extend its operations beyond the frontiers of its own country must do so with its own resources and at its own risk. It can not expect support from the taxpayers of the fatherland. Such support is not only unjust to the taxpayers and to other industries; in the long run it is injurious to the favored industry itself, and an industry which can not freely encounter competition does better not to enter into the lists at all.

The article then proceeds to consider the prospects of the sugar industry after a reduction of the bounty. As respects methods of cultivation and manufacture, the sugar industry of Germany is superior to that of any other nation; and if other German industries are able, under less favorable conditions, to compete successfully with other countries, the sugar industry may reasonably be called on to do the same. An examination of statistics leads to the same conclusion. The European production of sugar last year was as follows:

Countries.	Quantity.	Countries.	Quantity.
	Cwt.		*Cwt.*
Germany	20,200,000	Belgium	1,900,000
Austria	10,500,000	Holland	1,000,000
France	10,000,000		
Russia	9,400,000	Total	53,000,000

The export from Germany in the last five years is estimated to have been as follows:

Years.	Quantity.	Years.	Quantity.
	Cwt.		*Cwt.*
1882–'83	9,400,000	1885–'86	10,000,000
1883–'84	11,900,000	1886–'87	13,000,000
1884–'85	13,500,000		

These figures show that German sugar plays a leading part in the markets of the world and that foreign countries are largely dependent on Germany for their supplies. The only competition to be feared is that of France, and even here it is to be remarked that a long time will elapse before France is in a position to raise its production from 10,000,000 to 20,000,000 cwt., and when it has done so the increased consumption in the world will probably leave France in the same position as now. There is, consequently, no reason to fear that sugar factories will work with no profit if the export bounties are withdrawn.

Two classes of bounties have to be distinguished in Germany, the bounty on raw sugar and the special export bounty on refined sugar. The manufacturer of raw sugar is generally a farmer also and cultivates large areas of ground. He pays 85 pfennigs (20¼ cents) tax per cwt. of beets and receives 9 marks ($2.14⅕) returned on the export of each cwt. of raw sugar, so that he presumably uses about 10½ cwt. of beets to produce 1 cwt. of sugar. In point of fact he only uses 8½, so that he gets about 2 marks surplus bounty on each cwt. of manufactured sugar. The refiners are a smaller and, for the state, less important class than the farmer manufacturers of raw sugar, but they receive greater benefits. The tax paid by the refiners on raw sugar (that is, the difference between the home and export prices) is, as above, 9 marks per cwt. Ten cwt. of raw sugar produce nine of refined, so that the export bounty should not exceed 10 marks. In fact it amounts to 11.10 marks ($2.64), so that the state loses 1.10 marks (26 cents) on every cwt. of refined sugar exported. This inequality is not removed by the new proposals for the reduction of the bounties, inasmuch as the tax on raw sugar is reduced to 8.63 marks and the export bounty on refined sugar to 10.75 marks. Strictly, the export bounty should be reduced to 9.58 marks, so that the new proposal would produce a loss to the state of 1.17 marks per cwt. In other words, the state will collect some 20,000,000 marks from the farming manufacturers of raw sugar to return the bulk into the pockets of the few refiners, while only a million or two will come into the treasury. This form of the proposal is no doubt due to the great political influence of the refiners; but the article concludes with the belief that the Imperial Government and the Reichstag will nevertheless view the matter more in the light of the general welfare and protect the interests of the many against those of the few.

SAM'L ROLFE MILLAR, *Consul.*

UNITED STATES CONSULATE,
Leipsic, Germany, July 21, 1887.

GERMANY—1887.

REPORT BY CONSUL-GENERAL RAINE, OF BERLIN.

Beet-sugar production in the German Zollverein, years 1881–'82 *to* 1885–'86.

[Ton, 22 cwt.; pound, one-half kilogram; 100 kilograms, 2.2 cwt.]

Year.	Factories in operation.	Factories obtaining juice by—		Beets worked.	Produced by the factories.		Quantities obtained.		
		Diffusion.	Pressing, centrifugal filtermaceration.				Filling mass.	Raw sugar product of all kinds.	Molasses.
				Tons.	*Tons.*	*On acres.*	*Tons.*	*Tons.*	*Tons.*
1881–'82	343	324	19	6,271,948	3,431,754	303,140	774,004	599,722	150,813
1882–'83	358	343	5	8,747,154	4,448,632	323,155	1,097,508	835,165	196,305
1883–'84	376	368	8	8,918,130	4,205,064	352,107	1,216,879	940,109	207,978
1884–'85	408	402	6	10,402,688	4,936,246	375,193	1,448,619	1,123,030	259,700
1885–'86	399	395	4	7,070,317	4,199,047	347,173	1,025,777	808,105	180,178

Year.	Obtained from 100 kilograms of taxed beets.			Obtained from 100 kilograms.		Quantities of beets required to obtain 1 kilogram (=2.2 pounds) of raw sugar.
	Filling mass.	From the filling mass.		Raw sugar.	Molasses.	
		Raw sugar.	Molasses.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1881–'82	27.14	21.03	5.28	170.45	42.85	23.01
1882–'83	27.61	21.01	4.92	167.42	39.35	23.03
1883–'84	27.30	21.08	4.66	154.50	34.18	18.98
1884–'85	30.64	23 73	5.50	170.54	39.44	20.24
1885–'86	31.92	25.14	5.61	173.31	38.63	19.25

By German act of July 9, 1887, a new mode of taxation was adopted (as reported in dispatch No. 271, dated July 26, 1887), to take effect August 1, 1877. The extraordinary development of the sugar industry in recent years is striking. The average consumption per head of the population of the chief sugar-consuming countries in the periods mentioned is reported as follows:

Country.	Year.	Kilos.	Country.	Year.	Kilos.
Great Britain	1876–'80	28.07	France	1876–'79	8.50
United States	1876–'80	17.11	Switzerland	1875–'79	8.34
Denmark	1875–'79	11.70	Germany	1874–'79	6.55
Holland	1878–'79	10.80			

From 1881–'86 the consumption has rapidly increased, on an average per head of nearly 9 kilograms, while Great Britain's consumption shows one of 32 kilograms per head.

Great Britain's high average is as remarkable as Germany's low one, and it is but natural, therefore, that the former remains chief consumer of Germany's sugar. From the 1st day of January to the 30th of Octo-

ber, 1887, Germany imported in 100 kilograms (2.2 cwts.) 35,568 (against 27,624 of same period in 1886), but exported 4,413,892 100 kilograms (against 4,069,706 in same time 1886), viz:

Country.	100 kilos.	Country.	100 kilos.
Great Britain	2,574,000	United States	81,843
Netherlands	300,444	Russia	50,259
Sweden	108,104	Belgium	47,460
Switzerland	98,742		

Prices remain, notwithstanding, low. Taking the two German chief sugar-producing cities, Cologne and Magdeburg, I find the following official price quotations per 100 kilograms:

Year.	Raw sugar.		Refined sugar.	
	Cologne.	Magdeburg.	Cologne.	Magdeburg.
	Marks.	*Marks.*	*Marks.*	*Marks.*
1879	64.9	62.6	79.1	77.2
1883	62.5	59.9	76.7	74.6
1886	45.2	42.9	55.8	54.3
1887 (October)	44.22	41.88	55.50	54.02

The consumption of German sugar abroad increased from the year 1870 to 1885 by 46.12 per cent., that in Germany by 105 per cent. As to the causes of the increased exports in recent years this plus can not be explained alone by the greater wants of the international market; but the technical progress of German sugar industry must also be taken into consideration.

As the German tax on beets is intended to be a consumption tax [Export says] it is but justified that in case of exportation such tax is restored to the exporter; for it is clear that the consumer in the international market, receiving offers of sugar from all directions, will not be willing to pay a German tax. Now, actually, for the sugar exported not only the tax paid is returned, but there is also paid a bonus, which bonus assumes the character of an export bounty. This bounty has induced an enormous increase of sugar production and a rapidly augmented exportation of sugar.

In the years from 1871 to 1885 the excess of bounties paid over the beet tax amounted to 5,737,274 marks.

The results of an official international meeting held at London a short time ago to do away, if possible, entirely with all export bounties on sugar, have not yet been officially published. In principle this export bounty has been disapproved also by German beet-sugar manufacturers in a recent meeting, though these latter claim to be still dependent on it in practice.

F. RAINE,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, February 15, 1888.

GERMANY—1887.

REPORT BY COMMERCIAL AGENT SMITH, OF MAYENCE.

REFORM OF SUGAR TAX.

About as prominent a question at the last session of the Reichstag was the reform of the sugar tax. The Government for a long time has been paying a bounty, as it were, upon sugar, and an urgent demand has been made for several years past from various quarters for a revision of the tax upon sugar, so that this anomaly should cease. By a law passed in 1869 it was assumed that it took 12½ centners of beet-roots to give one centner of crude sugar, and a tax was levied on this basis and a corresponding drawback allowed on exported sugar. Since then great improvements have been made in the process of manufacturing, so that but 10½ centners of roots are necessary to produce one centner of sugar instead of 12½, as formerly, but the Government continued to grant a drawback on the basis of 12½. The export drawback thus became an enormous premium to the producers, and the German sugar manufacturers have been able to supply all Europe with cheap sugar, till to protect themselves different states had to increase their duties on foreign sugar. The industry has bloomed and astonishing dividends been paid. But the large profits at last led to overproduction and a crisis in the trade, and the export bounty cost the German Government about $5,000,000. A new law has been passed this year remedying the old to some extent. Under it, from August, 1886, the tax on sugar is to be 1.75 marks (41½ cents) per 100 kilograms (220 pounds). The export drawback upon the same quantity of raw sugar of at least 90 per cent. polarization and upon refined sugar of 90 to 98 per cent. will be 18 marks ($4.28) for the first year, and afterwards 17.25 marks ($4.10). On candies and on sugar in white hard loaves, blocks and bars, the drawback is 22.20 marks ($5.28) for this year and 21.25 marks ($5.05) hereafter. On all hard sugar and on all white dry sugar in crystal, crumb, or flour form of at least 90 per cent. polarization the bounty is 20.80 marks ($4.95) to August 1887, and 20.15 marks ($4.79) thereafter.

J. H. SMITH,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Mayence, January 8, 1887.

GERMANY—1888.

REPORT BY CONSUL-GENERAL EDWARDS, OF BERLIN.

INTRODUCTORY.

I have the honor to submit herewith a report relating to the production, fabrication, taxation, and consumption of beet-root sugar in Germany, together with tables marked A, B, C, D, E, F, and G, containing

statistical information concerning the condition and progress of the beet-root sugar industry in Germany.

Attention is especially directed to the conditions, modifications, and operations of the material and consumption taxes, as described and explained in the report. The result of the operations of the taxes in question may be seen from an examination of Table A. It will be observed that under the operations of the material tax Hamburg paid nothing, but received, as a rebate on the different classes of exports, the sum of 18,421,851 marks.* The rebate allowances accorded by the federal council are fully explained in the report, and the articles directly affected specified by name.

The beets are planted on land belonging to or rented by the factories. Whenever the factory directors do not plant their own beets, they write down very exactly the rules for cultivation, direct and oversee the manuring and working of the beet fields. The factories purchase only from those who have pledged themselves to cultivate the beets in accordance with fixed regulations.

By reference to the table marked D it will be observed that during the year 1888–'89 the factories raised 53.3 per cent. and purchased 46.7 per cent. of the entire quantity of beets used. The prices, it will be seen by reference to the report, depend upon the percentage of sugar contained in the beet, and not, as formerly, upon the weight of the beet. Table D also shows the number of factories in operation from 1871–'72 to 1888–'89. It will be seen, by reference to the same table, that the press system has gradually given way to the diffusion process.

Special mention is made in the report as to improvement introduced in the factories during the year 1888–'89.

I beg to invite your attention to the inclosed clipping from the London Times of January 24, 1890, which pretends to explain the causes of the movement in the prices of sugar during the year 1888–'89.

THE REPORT.

With the beginning of the year 1888–'89 the provisions of the law of July 9, 1887, concerning the taxation of sugar, were put into operation. This law, in addition to the old material tax on the weight of beets used in the fabrication of sugar, imposed a consumption tax on the weight of sugar placed upon the home market. Before August 1, 1888, beet sugar was taxed only to the extent that the raw roots destined to the manufacture of sugar were subject to a weight duty. This duty, in the fiscal years 1886–'87 and 1887–'88, amounted to 1.70 marks on 100 kilograms of raw beets.† In the preceding years, as far back as September, 1869, it was 1.60 marks. The material tax introduced in 1888–'89 amounts to 0.80 mark per 100 kilograms, a decrease of 0.90 mark as compared with the preceding year. But there is, in addition to this, a consumption tax of 12 marks per 100 kilograms of inland beet sugar,

*1 mark = 23.8 cents. †1 kilogram = 2,205 pounds.

that is, on all sugar which is manufactured in inland factories from beets, or products of sugar fabrication (sirup and molasses), or by further finishing processes, from such sugar (refining, etc.). This consumption tax is due so soon as the sugar passes from the revenue control, under which it has lain during the manufacturing and refining process, into the open market. Only sirup and molasses are free from this consumption tax, and even upon these the federal council is empowered to impose the consumption tax, partially or in full, when the condition of such drippings is such as to fit them for finer uses. According to section 6 of the law of July 9, 1887, all drippings which in the dry substance contain 70 per cent. or more of sugar are subject to the consumption tax of 12 marks per 100 kilograms.

The material tax for sugar which is exported beyond the customs frontier, or which is kept in bond in public or private warehouses, when the amount is at least 500 kilograms, is refunded per 100 kilograms as follows:

(*a*) For raw sugar of at least 90 per cent. fine, and for refined sugar containing less than 98 per cent., but at least 90 per cent. of sugar, 8.50 marks.

(*b*) For candies, and for sugars in white, full, hard loaves, blocks, plates, sticks, or cubes, or broken small in the presence of revenue officers; for so-called crystals, or for other white, hard, translucent sugar in crystal form, containing at least 99½ per cent. of sugar, particularly the sort known in trade as granulated; further, for other sugars of at least 99½ per cent. purity, which at any time may be thus classified by the federal council, 10.65 marks.

(*c*) For all other hard sugars, as well as for all white, dry (not containing over 1 per cent. water) sugars in crystal, crumb, or flour form, containing at least 98 per cent. sugar, so long as they do not fall under *b*, 10 marks.

The sugar lying in public or private warehouses, upon payment of the tax, may be placed upon the domestic market.

Upon the exportation of wares in whose manufacture sugar of all sorts described in *a*, *b*, and *c* has been used, or upon the storing of such wares in public or private warehouses, under official surveillance, according to the decision of the federal council, the material tax and the already paid consumption tax on the amount of sugar contained in the wares is to be refunded. The federal council has accorded this privilege to the following articles: Condensed milk, chocolate, conditor's wares (dragées, desert bonbons, marzipan, cakes, and similar baked wares, sugared southern and other fruits glazed and candied, as well as fruits preserved in sugar), alcoholic fluids containing sugar, namely, sweetened spirits (liqueurs), as well as fruit juices and brandies cooked with sugar and mixed with alcohol, and further, to fluid refined sugar and that known in trade as fruit sugar. If such goods are taken from the warehouse where they have been stored in bond, the material and consumption taxes must be paid. For the transition period from August 1

to October 1, 1888, certain lightenings of the new regulations were allowed, and particularly for such cases in which the sugar has been produced before the revenue officers before August 1, and its identity established by its having been stored in bond; or in which the revenue officers, on August 1, in the sugar factory, had made an inventory of the supplies on hand of raw sugar or unfinished wares, and had reckoned the product therefrom of finished sugar; or in which the sugar came from factories which, during the term in question, had not used beets or procured sugar or sugar drippings elsewhere, or only so far as their origin in the preceding fiscal period was beyond doubt. The modifying of the taxes in these cases consisted in this, that upon exportation, or storing in bonded warehouses, a rebate was allowed amounting on 100 kilograms of sugar, class *a*, to 17.25 marks; class *b*, to 21.50 marks; class *c* to 20.15 marks; or, upon being placed on the inland market, the consumption tax was remitted. For sugar from foreign countries (all kinds, with the exception of sirup and molasses) since August 1, 1888, the import duty has been 30 marks per 100 kilograms. Previously this rate of duty had been only for refined sugar and such raw sugars as reached the Dutch standard No. 19, while other raw sugars paid 24 marks per 100 kilograms. When foreign sugar is introduced for further manufacture in a sugar factory, the amount of the consumption tax (12 marks per 100 kilograms) can be deducted and only 18 marks per 100 kilograms collected in customs duties.

As in the second half of the year 1887–'88 the condition of sugar prices was not unfavorable, and as, consequently, the coming campaign could be looked forward to with some degree of confidence by the sugar factories, more sugar beets were planted in 1888 than in the preceding year. If, notwithstanding this, in the year 1888–'89 not more beets were used nor a much larger mass of sugar produced than 1887–'88, these facts were due to the weather of 1888.

The late winter delayed planting partially until May. The frequent rains in the months of June and July promoted, it is true, the growth of the beet; but the lack of heat was unfavorable to the development of the sugar ingredients, and the more favorable weather of August could not remedy the injury. If, therefore, the crop in quantity exceeded that of the preceding year, it fell behind in quality, the beet of 1887, according to the reports of Magdeburg officials, having been equaled by that of no previous year in the amount of sugar contained in it. Furthermore, the frosts in the early part of November did great damage, because at that time many of the factories still had a large portion of their beets in the ground. It is true that work was at once begun with the frozen beets, though—a thaw setting in at the end of November—the great supply on hand could not be used with sufficient rapidity. The juices of the thawed-out beets were to such an extent rendered impure by a slimy substance (the so-called beet gum) that they could only with difficulty, and often not at all, be filtered by

means of the presses. The cooking in vacuum was also difficult in many factories, so that some of the manufacturers gave up the attempt to use the frozen beets. Similar reports concerning the injuries from frost, which rendered a part of the beet crop useless in sugar fabrication and consequently disturbed business, were made from nearly all the North German directive districts. In general, however, the condition of the beets used was favorable, though their quality did not equal that of the preceding year. In regard to the cultivation and production of beets no important changes were introduced. As formerly, the beets were either planted on land belonging to or rented by the factories or obtained from others who had pledged themselves to cultivate the beets in accordance with fixed regulations. Whenever the factory directors do not plant their own beets they write down very exactly the rules for cultivation, direct and oversee the manuring and working of the beet fields. It is more and more becoming the custom of the factories not to pay for the beets by weight, but to take also into consideration the amount of contained sugar. The best delivery contracts fix for a certain price a certain percentage of sugar in the beet, for any thing in excess of which additional prices are paid. Often, moreover, these contracts contain the provision that, if the beets do not produce a certain percentage of sugar, they may be refused. For 100 kilograms of beets from 1.5 to 2.5 marks were paid, the usual price being from 1.8 to 2 marks.

No special technical improvements or inventions are reported as having been practically introduced during the year 1888–'89, though many of the factories were more thoroughly equipped. The improvements were chiefly in the direction of economizing in the use of steam, the strengthening and improvement of the diffusion batteries, the introduction of the process of purifying the juice with sulphuric acid, the adoption of new filter presses, etc. In some factories a new system has been tried with more or less success, by which raw sugar, by means of systematic washing, is freed from molasses and converted into white sugar fit for consumption.

The manufacture of sugar from molasses, as compared with the preceding year, showed a decline in 1888–'89, in 1887–'88 167 factories producing sugar from molasses as well as from beets, while in 1888–'89 there were only 115. Of these 45 used the Osmose process (1887–'88, 84; 1886–'87, 55; 1885–'86, 78; 1884–'85, 79; 1883–'84, 115; 1882–'83, 124; and 1881–'82, 135), and probably the use of this costly process would have been still more diminished had it not been for the rise in the prices of sugar, owing to which the price of Osmosist sugar at the end of the year was higher than that of the first product at the beginning of the campaign. The elution process is in use in 40 factories (1887–'88, 48; 1886–'87, 46; 1885–'86 and 1884–'85, 51; 1883–'84, 46; 1882–'83, 50; and 1881–'82, 44). The substitutson process was used in 5 (1887–'88, 9; 1886–'87, 1885–'86, and 1884–'85, 10; 1883–'84, 13; 1882–'83, 8; 1881–'82, 4). The settling process was used in 2 (1887–'88, 3; 1886–'87, 2; 1885–

'86, 4; 1884–'85, 5; 1883–'84, 4; 1882–'83, 6; and 1881–'82, 4). The separation process was used in 20 (1887–'88, 20; 1886–'87, 17; 1885–'86, 16; 1884–'85, 13; and 1882–'83, 2). The strontian process was in use in 3 (1887–'88, 1886–'87, 1885–'86, 1884–'85, and 1883–'84, each 3). In regard to the costs of fabrication only to a limited extent were reports made, and these were calculated differently. In general, however, it appears that these expenses were somewhat larger than in the preceding year, because the beet price and, to an extent, the wages of labor were higher. In comparison with the preceding year the saving in the beet tax (0.90 mark on the 100 kilograms, see above) more or less equalized the increase in cost of production. From the beginning of the campaign until December sugar prices fell not inconsiderably, but in that month they recovered again somewhat, and remained at about the same height during the two following months. From the month of March on, however, the influence of a high-price union (sugar trust) in Magdeburg made itself felt, and prices rose very high, though in July a very great fall followed. The price rise in the spring of 1889 occasioned the unusual circumstance that most of the factories were able to dispose of their seconds for higher prices than they got for their first products.

A.—*Amount of tax on inland sugar and customs duty on foreign sugar, together with the amount of sugar products placed in the open market in the year* 1888–'89.

District.	Income from material tax.			
	Sugar material tax (beet tax.)			Material tax for sugar and wares containing sugar (taxes paid on wares taken from warehouses.)*
	Gross receipts.	Less for exported or warehoused sugar.*	Net receipts.	
	Marks.	*Marks.*	*Marks.*	*Marks.*
East Prussia	271, 028	127, 601	143, 427	.....
West Prussia	2, 981, 311	5, 479, 886	—2, 498, 575	5, 822
Brandenburg	1, 263, 948	124, 412	1, 139, 536	.....
Pomerania	1, 258, 418	3, 329, 910	—2, 071, 492	489, 521
Posen	3, 820, 274	1, 042, 560	2, 777, 714	.....
Silesia	8, 197, 265	4, 939, 389	3, 257, 876	836, 452
Province of—				
Saxony	22, 224, 126	21, 534, 662	689, 464	2, 976, 711
Schleswig-Holstein	192, 933	1, 317, 502	—1, 124, 569	707, 797
Hanover	6, 769, 688	3, 060, 912	3, 708, 776	46, 617
Westphalia	747, 972	168, 858	579, 114	7, 173
Hessen-Nassau	529, 964	172, 181	357, 783	.....
Rhineland	2, 002, 642	5, 126, 977	—3, 124, 335	771, 825
Total Prussia	50, 259, 569	46, 424, 850	3, 834, 719	5, 841, 918
Bavaria	161, 560	5, 122 442	—4, 960, 882	2, 194, 204
Saxony	565, 356	11, 659	553, 697	.....
Würtemburg	454, 568	9, 516	445, 052	4, 689
Baden	175, 672	712, 764	—537, 092	206, 396
Hessen	514, 336	252, 920	261, 416	.....
Mecklenburg	1, 027, 727	81, 107	946, 620	258
Thuringia	1, 086, 325	41, 535	1, 044, 790	.....
Brunswick	4, 824, 736	3, 515, 353	1, 309, 383	130, 659
Anhalt	4, 099, 669	2, 958, 747	1, 140, 922	138, 701
Lübeck	.....	2, 783	—2, 783	.....
Bremen	.....	2, 520, 526	—2, 520, 526	.....
Hamburg	.....	18, 421, 851	—18, 421, 851	5, 625
Total for German customs district	63, 169, 518	80, 076, 053	—16, 906, 535	8, 522, 450

* As classified in section 6 of the law of July 9, 1887.

A.—*Amount of tax on inland sugar and customs duty on foreign sugar, etc.*—Continued.

District.	Income from consumption tax.			Receipts from customs duties on foreign sugar.	Total receipts.
	Gross receipts.	Less for exported or warehoused wares.	Net receipts.		
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*
East Prussia	260,032	.....	260,032	4,035	407,494
West Prussia	312,746	.....	312,746	17,730	—2,162,277
Brandenburg	712,143	.....	712,143	29,370	1,881,049
Pomerania	393,926	.....	393,926	39,330	—1,148,715
Posen	693,995	.....	693,995	660	3,472,369
Silesia	7,140,226	.....	7,140,226	9,405	11,243,959
Province of—					
Saxony	8,371,303	.....	8,371,303	35,745	12,073,223
Schleswig-Holstein	1,158,354	.....	1,158,354	58,410	799,992
Hanover	1,020,555	.....	1,020,555	76,965	4,852,913
Westphalia	137,751	.....	137,751	2,100	726,138
Hessen-Nassau	86,552	.....	86,552	17,625	461,960
Rhineland	5,191,583	.....	5,191,583	104,235	2,943,308
Total, Prussia	25,479,166	.....	25,479,166	395,610	35,551,413
Bavaria	3,924,682	22,395	3,902,287	74,280	1,209,889
Saxony	645,213	841	644,372	38,355	1,236,424
Würtemburg	736,921	.....	736,921	3,075	1,189,737
Baden	1,210,311	.....	1,210,311	105,318	984,933
Hessen	261,925	.....	261,925	613,359	1,136,700
Mecklenburg	732	.....	732	12,510	960,120
Thuringia	517,649	.....	517,649	1,980	1,564.419
Oldenburg	.....	.....	.....	795	795
Brunswick	2,485,930	.....	2,485,930	15,855	3,941,827
Anhalt	1,692,067	.....	1,692,067	90	2,971,780
Lübeck	.....	.....	.....	26,820	24,037
Bremen	813	.....	813	33,960	—2,485,753
Hamburg	69,482	.....	69,482	57,735	—18,289,009
Alsace-Lorraine	.....	.....	.....	90,450	90,450
Luxemburg	.....	.....	.....	7,305	7,305
Total for German customs district	37,024,891	23,236	37,001,655	1,477,497	30,095,067

A.—*Amount of tax on inland sugar and customs duty on foreign sugar, etc.*—Continued

District.	In the open market.			
	Inland beet sugar.		Sirup and molasses paying consumption tax.	Total.
	Paying consumption tax.	Not paying consumption tax.		
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
East Prussia	21,670	.....	.....	21,670
West Prussia	26,062	1,609	.....	27,671
Brandenburg	59,345	10,129	.....	69,474
Pomerania	32,816	12,471	12	45,299
Posen	57,833	4,066	.....	61,899
Silesia	595,031	57,701	.....	652,732
Province of—				
Saxony	697,581	83,861	.....	781,442
Schleswig-Holstein	96,530	33,976	.....	130,506
Hanover	85,048	3,335	.....	88,383
Westphalia	11,510	254	25	11,789
Hessen-Nassau	7,213	312	.....	7,525
Rhineland	432,389	.....	249	432,638
Total, Prussia	2,123,028	207,714	286	2,331,028
Bavaria	327,063	75,314	.....	402,377
Saxony	53,467	16,385	302	70,154
Würtemburg	61,416	24,914	.....	86,335
Baden	100,859	40,918	.....	141,777
Hessen	21,827	196	.....	22,023
Mecklenburg	61	.....	.....	61
Thuringia	43,138	9,639	.....	52,777
Brunswick	207,164	40,284	.....	247,448
Anhalt	141,007	39,003	3	180,013
Bremen	68	.....	.....	68
Hamburg	5,149	298	641	6,088
Total for German customs district	3,084,247	454,670	1,232	3,540,149

B.—*German sugar trade with foreign countries in* 1888–'89.

IMPORTATION.

Country.	Refined sugar, all sorts.	Raw sugar.	Sirup.	Molasses.	Glucose, starch, sugar, and sirup.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
Parts of Germany not in Zollverein	961	323	2,605	.....	31
Belgium	2,213	519	1	.....	31
Denmark	66	111	74	.....	.....
France	2,315	157	618	.....	11
Great Britain	3,104	11,985	13,206	.....	100
Italy	2	99	.....	.....	.....
Netherlands	9,889	5,517	587	.....	14
Russia	7	52	2	.....	.....
Sweden	1	.....	.....	.....	.....
Switzerland	50	.....	2	.....	2
Asia	306	1,168	.....	.....	.....
America	142	149	1,123	2	32
Other lands	22	84	21	.....	3
Total	19,078	20,164	21,239	2	224
Total in 1887–'88	13,314	43,274	26,837	5	145

EXPORTATION.

Country.	Sugar of the rebate classes.			Sugar for which rebates are not provided.	Sirup.	Molasses.	Glucose, starch, sugar, and sirup.
	(*a*.)	(*b*.)	(*c*.)				
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
Parts of Germany not in Zollverein	1,035,158	475,015	74,948	154	2,899	15,532	20,239
Belgium	8,244	45,521	1,682	88	16	31,961	230
Denmark	9,426	17,703	4,693	2	53	.....	1,009
France	.....	102	.....	63	.....	180,362	11
Great Britain	2,322,199	735,253	36,782	9	2,330	747	95,870
Italy	.....	57	.....	.....	.....	2,142	4
Netherlands	483,472	59,210	1,379	60	89	.....	171
Norway	.....	30,604	5,368	2	154	2,356	240
Roumania	50	33,427	1,596	.....	25	.....	1,319
Russia	2,113	47,847	3,061	8	81	.....	93
Sweden	98,942	80,828	4,252	6	84	2,919	765
Switzerland	838	95,818	.....	10	297	3,171	2,340
Asia	.....	331	.....	4	2	.....	.....
America	158,845	15,917	21,068	16	108	7	4,639
Other lands	4,955	3,885	1,677	31	353	11	3,236
Total	4,124,242	1,641,518	156,506	453	6,491	239,208	130,166
Total in 1887–'88	3,447,108	1,322,128	207,438	546	3,043	572,420	259,444

C.—*Results of the beet-sugar fabrication in the German customs territory.*

Business year.	Produced from taxed beets.			
	Sugar in mass.	Salable products.		
		Raw sugar of all sorts.	Molasses.	Total.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	2, 629, 931	1, 864, 419	638, 917	2, 503, 336
1872–'73	3, 716, 170	2, 625, 511	915, 887	3, 541, 398
1873–'74	4, 121, 142	2, 910, 417	1, 058, 181	3, 968, 598
1874–'75	3, 680, 442	2, 564, 124	976, 028	3, 540, 152
1875–'76	5, 028, 183	3, 580, 482	1, 339, 524	4, 920, 006
1876–'77	4, 055, 036	2, 894, 227	1, 111, 011	4, 005, 238
1877–'78	5, 155, 951	3, 780, 091	1, 228, 128	5, 008. 219
1878–'79	5, 761, 803	4, 261, 551	1, 336, 515	5, 598, 066
1879–'80	5, 544, 094	4, 094, 152	1, 313, 709	5, 407, 861
1880–'81	7, 393, 360	5, 559, 151	1, 649, 842	7, 208, 993
1881–'82	7, 740, 044	5, 997, 222	1, 508, 129	7, 505, 351
1882–'83	10, 935, 556	8, 319, 953	1, 963, 047	10, 283, 000
1883–'84	12, 168, 794	9, 401, 093	2, 079, 781	11, 480, 874
1884–'85	14, 486, 187	11, 230, 303	2, 596, 997	13, 827, 300
1885–'86	10, 257, 772	8, 081, 049	1, 801, 775	9, 882, 824
1886–'87	12, 459, 832	9, 856, 278	2, 158, 872	12, 015, 150
1887–'88	11, 239, 290	9, 106, 984	1, 830, 369	10, 937, 353
1888–'89	11, 653, 469	9, 445, 046	2, 011, 890	11, 456, 936

Business year.	Produced from 100 kilograms of taxed beets.				Produced from 100 kilograms of sugar in mass		Quantity of beets required for production of 100 kilograms of raw sugar.
	Sugar in mass.	Salable products.					
		Raw sugar of all sorts.	Molasses.	Total.	Raw sugar of all sorts.	Molasses.	
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	100 *kilos.*
1871–'72	11. 68	8. 28	2. 84	11. 12	70. 89	24. 29	12. 07
1872–'73	11. 68	8. 25	2. 88	11. 13	70. 65	24. 65	12. 11
1873–'74	11. 68	8. 25	3	11. 25	70. 62	25. 68	12. 12
1874–'75	13. 35	9. 30	3. 54	12. 84	69. 67	26. 52	10. 75
1875–'76	12. 08	8. 60	3. 22	11. 82	71. 21	26. 64	11. 62
1876–'77	11. 42	8. 15	3. 13	11. 28	71. 37	27. 40	12. 27
1877–'78	12. 60	9. 24	3	12. 24	73. 32	23. 82	10. 82
1878–'79	12. 45	9. 21	2. 89	12. 10	73. 96	23. 20	10. 86
1879–'80	11. 54	8. 52	2. 73	11. 25	73. 85	23. 70	11. 74
1880–'81	11. 69	8. 79	2. 61	11. 40	75. 19	22. 32	11. 37
1881–'82	12. 34	9. 56	2. 40	11. 96	77. 48	19. 48	10. 46
1882–'83	12. 50	9. 51	2. 24	11. 75	76. 08	17. 95	10. 51
1883–'84	13. 65	10 54	2. 33	12. 87	77. 25	17. 09	9. 49
1884–'85	13 93	10. 79	2. 50	13. 29	77. 52	17. 93	9. 26
1885–'86	14. 51	11. 43	2. 55	13. 98	78. 78	17. 56	8. 75
1886–'87	15	11. 87	2. 60	14. 47	79. 10	17. 33	8. 43
1887–'88	16. 14	13. 08	2. 63	15. 71	81. 03	16. 29	7. 65
1888–'89	14. 76	11. 96	2. 55	14. 51	81. 05	17. 26	8. 36

D.—*Production and use of beets.*

[The years from 1871–'72 to 1879–'80 are reckoned from September 1 to August 31; the year 1880–'81 is reckoned from September 1 to July 31; the following years are reckoned from August 1 to July 31:]

Year.	Number of factories in operation.	Steam machines used.		Number of factories using the different processes.		
		Number.	Horse-power.	Diffusion.	Press system.	Other systems.
1871–'72	311	1,921	18,162	52	216	43
1872–'73	324	2,076	19,923	63	220	41
1873–'74	337	2,203	21,954	80	214	43
1874–'75	333	2,233	22,712	113	181	39
1875–'76	332	2,300	23,325	157	137	38
1876–'77	328	2,370	24,923	197	98	33
1877–'78	329	2,413	25,788	224	81	24
1878–'79	324	2,493	26,882	258	50	16
1879–'80	328	2,627	29,586	291	28	9
1880–'81	333	2,812	32,269	309	20	4
1881–'82	343	3,046	35,476	324	16	3
1882–'83	358	3,365	40,515	343	12	3
1883–'84	376	3,715	46,158	368	6	2
1884–'85	408	4,196	56,119	402	4	2
1885–'86	399	4,188	57,194	395	3	1
1886–'87	401	4,276	58,770	397	3	1
1887–'88	391	4,292	58,325	387	3	1
1888–'89	396	4,363	60,313	393	3	.....

Year.	Beets used.			Proportion to whole amount of beets used.	
	Cultivated by factory owners.	Purchased.	Total.	Raised.	Purchased.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	*Per cent.*	*Per cent.*
1871 '72	15,043,510	7,465,672	22,509,182	66.8	33.2
1872–'73	21,013,014	10,802,494	31,815,508	66	34
1873–'74	24,209,086	11,078,553	35,287,639	68.6	31.4
1874–'75	19,080,947	8,486,504	27,567,451	69.2	30.8
1875–'76	28,363,068	13,249,774	41,612,842	68.2	31.8
1876–'77	24,901,537	10,598,829	35,500,366	70.1	29.9
1877–'78	28,727,752	12,181,928	40,909,680	70.2	29.8
1878–'79	31,140,298	15,147,179	46,287,477	67.3	32.7
1879–'80	28,505,861	19,546,754	48,052,615	59.3	40.7
1880–'81	38,716,787	24,505,243	63,222,030	61.2	38.8
1881–'82	34,317,535	28,401,944	62,719,479	54.7	45.3
1882–'83	44,486,318	42,985,219	87,471,537	50.9	49.1
1883–'84	42,050,639	47,130,664	89,181,303	47.2	52.8
1884–'85	49,362,459	54,664,424	104,026,883	47.5	52.5
1885–'86	41,990,474	28,712,694	70,703,168	59.4	40.6
1886–'87	44,360,835	38,705,877	83,066,712	53.4	46.6
1887–'88	37,976,517	31,663,089	69,639,606	54.5	45.5
1888–'89	42,099,419	36,862,411	78,961,830	53.3	46.7

Year.	Amount of land from which beets raised by factory owners were harvested.	Amount produced per hectare.	Number of days' (12 hours) work consumed in process of extraction.	Amount of beets used in each day's work.
	Hectares.	100 *kilos.*		100 *kilos.*
1871–'72	73,690	204	64,451	349
1872–'73	82,590	254	87,677	363
1873–'74	88,877	272	91,254	387
1874–'75	92,655	206	70,020	394
1875–'76	96,724	293	91,675	454
1876–'77	98,725	252	70,608	503
1877–'78	104,783	274	75,320	543
1878–'79	107,679	289	75,895	610
1879–'80	113,003	252	70,909	678
1880–'81	118,431	327	82,052	771
1881–'82	121,256	283	76,325	822
1882–'83	129,262	344	94,816	923
1883–'84	140,843	299	89,956	991
1884–'85	150,077	329	97,065	1,072
1885–'86	138,869	302	65,642	1,077
1886–'87	147,782	300	72,593	1,144
1887–'88	143,853	264	59,856	1,163
1888–'89	149,411	282	67,727	1,183

E.—*German importation and exportation of sugar.*

IMPORTED.

Year.	Refined sugar.	Raw sugar.	Sirup and dutiable molasses.	Molasses for fabrication of spirits.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	127,305	315,832	73,298	81,341
1872–'73	124,886	97,562	69,323	23,716
1873–'74	161,483	84,148	61,021	50,422
1874–'75	141,010	89,133	56,587	50,335
1875–'76	145,273	24,526	48,397	4,748
1876–'77	77,097	10,172	53,189	28,600
1877–'78	49,153	11,674	41,028	7,054
1878–'79	39,012	15,304	38,329	31,827
1879–'80	29,831	16,764	28,996	72,369
1880–'81	22,654	12,652	33,220	48,510
1881–'82	22,016	15,049	33,139	4,588
1882–'83	21,038	23,705	35,369	3,611
1883–'84	15,577	18,763	32,216	1,695
1884–'85	12,683	20,668	33,372	2,816
1885–'86	12,300	26,203	28,942	.....
1886–'87	14,618	15,675	27,166	2
1887–'88	15,799	40,789	26,842	.....
1888–'89	19,078	20,164	21,241	.....

EXPORTED.

Year.	With export rebate.			Sugar without export rebate.	Molasses and sirup.
	Raw sugar, etc.	Candy sugar, etc.	Other hard sugars, etc.		
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	56,665	41,763	16,328	19,394	8,563
1872–'73	81,777	51,331	28,472	8,043	35,559
1873–'74	118,092	41,120	26,310	21,182	79,363
1874–'75	28,838	39,452	15,359	16,531	79,829
1875–'76	458,942	47,125	25,329	19,588	84,588
1876–'77	462,189	73,935	43,423	9,857	122,624
1877–'78	712,010	140,013	83,416	6,764	148,744
1878–'79	1,034,718	193,561	113,966	2,243	174,507
1879–'80	951,616	252,364	97,052	2,073	171,576
1880–'81	2,214,420	353,787	206,814	1,056	160,782
1881–'82	2,539,310	399,160	144,130	615	211,183
1882–'83	3,907,027	493,811	242,181	646	141,473
1883–'84	4,911,701	642,469	298,679	597	255,381
1884–'85	5,537,931	760,154	318,852	403	650,618
1885–'86	4,040,715	666,196	205,689	365	551,206
1886–'87	4,896,801	1,303,789	238,828	414	245,508
1887–'88	3,447,108	1,322,128	207,438	546	575,463
1888–'89	4,124,242	1,641,518	156,506	453	245,699

F.—*Average prices per* 100 *kilograms of sugar and molasses during the year ending July* 31, 1889.

[The prices for raw sugar are quoted without, for refined sugar with, the consumption tax.]

As reported by trade corporations.	August.	September.	October.	November.	December.	January.
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
Raw sugar:						
Brunswick, corn, 92 per cent. fine	47.30	48.00	34.65	34.68	36.38	36.38
Halle, corn, 92 per cent. fine	47.60	36.70	34.60	34.65	36.75	36.35
Cologne, light corn, of 96 per cent. polarization	49.80	50.40	36.92	37.15	38.16	37.84
Magdeburg, I product, corn, 92 per cent. fine	48.00	37.15	34.54	34.68	36.70	36.34
Stettin, 96 per cent. polarization	58.50	37.00	35.00	36.00	35.00	35.00
Refined sugar:						
Brunswick, ff melis (loaf)	58.75	59.00	58.63	58.00	58.75	58.63
Halle, fine (loaf)	58.50	58.50	58.20	57.80	58.50	58.00
Cologne, with small etiquettes	60.70	60.62	59.90	59.37	59.83	59.70
Madgeburg, fine (loaf)	57.90	58.00	.....	56.80	57.50	57.19
Stettin, Ia loaf	62.00	62.00	61.00	63.00	63.00	62.00
Molasses:						
Brunswick, unosmosirt, 43° Bé., without tun	6.00	6.00	6.08	7.40	7.35	6.45
Halle, unosmosirt, without tun	5.80	5.80	5.80	6.20	6.05	6.25
Magdeburg, without tun for spirit fabrication	4.72	4.80	4.80	4.80	.....	.....

F.—*Average prices per* 100 *kilograms of sugar, etc.*—Continued.

As reported by trade corporations.	February.	March.	April.	May.	June.	July.
Raw sugar:	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
Brunswick, corn, 92 per cent. fine...	36.70	41.05	48.63	.....	.....	.....
Halle, corn, 92 per cent. fine.....	36.70	41.05	50.05	50.70	.....	.....
Cologne, light corn, of 96 per cent. polarization.....	38.72	43.15	51.60	55.17	60.95	58.38
Magdeburg, I product, corn, 92 per cent. fine.....	36.71	41.09	49.80	52.21	.....	51.00
Stettin, 96 per cent. polarization....	37.75	43.50	50.00	53.00	57.00	50.00
Refined sugar:						
Brunswick, ff melis (loaf)	58.63	61.50	69.63	74.00	74.60	75.25
Halle, fine (loaf)	58.00	61.60	70.25	74.30	76.15	76.50
Cologne, with small etiquettes	59.00	64.00	71.50	75.50	78.25	79.00
Magdeburg, fine (loaf)	56.92	61.00	69.81	.....	75.41	74.58
Stettin, Ia loaf	63.50	69.00	72.00	76.00	86.00	79 00
Molasses:						
Brunswick, unosmosirt, 43° Bé, without tun.....	6.15	6.10	7.16	7.50	7.68	7.80
Halle, unosmosirt, without tun	6.20	6.15	7.00	7.55	7.80	.....
Magdeburg, without tun for spirit fabrication	5.80	5.47	5.40	7.10	6.50	.....

G.—*Consumption of sugar and amount of sugar taxation in the German customs territory.*

Year.	Production of raw sugar.	Importation of sugar, reduced to the basis of raw sugar.	Total.	Exportation of sugar, reduced to the basis of raw sugar.	Consumption of sugar.	Consumption per head of population.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	*Kilos.*
1871–'72	1, 864, 419	496, 332	2, 360, 751	142, 757	2, 217, 994	5.5
1872–'73	2, 625, 511	270, 852	2, 896, 363	179, 382	2, 716, 981	6.6
1873–'74	2, 910, 407	289, 530	3, 199, 937	216, 550	2, 983, 387	7.2
1874–'75	2, 564, 124	276, 907	2, 841, 031	108, 134	2, 732, 897	6.5
1875–'76	3, 580, 482	212, 532	3, 793, 014	561, 209	3, 231, 805	7.6
1876–'77	2, 894, 227	125, 060	3, 019, 287	603, 538	2, 415, 749	5.6
1877–'78	3. 780, 091	88, 830	3, 868, 921	967, 785	2, 901, 136	6.7
1878–'79	4, 261, 551	79, 710	4, 341, 261	1, 380, 768	2, 960, 493	6.7
1879–'80	4, 094, 152	65, 842	4, 159, 994	1, 344, 857	2, 815, 137	6.3
1880–'81	5, 559, 151	56, 073	5, 615, 224	2, 839, 039	2, 776, 185	6.8
1881–'82	5, 997, 222	57, 330	6, 054, 552	3, 144, 103	2, 910, 449	6.4
1882–'83	8, 319, 953	66, 012	8, 385, 965	4, 725, 514	3, 660, 451	8.1
1883–'84	9, 401, 093	53, 761	9, 454, 854	5, 958, 144	3, 496, 710	7.7
1884–'85	11, 230, 303	53, 035	11, 283, 338	6, 737, 274	4, 546, 064	9.9
1885–'86	8, 081, 049	55, 745	8, 136, 794	5, 003, 215	3, 133, 579	6.8
1886–'87	.....	.....	.....	.....	3, 614, 756	7.7
1887–'88	.....	.....	.....	.....	3, 981, 631	8.4
1888–'89	.....	.....	.....	.....	3, 575, 975	7.4

Year.	Taxes.					
	Taxes on beets and sugar.	Customs duty.	Total.	Tax rebates.	Net receipts.	Per head of population.
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
1871–'72	36, 015, 000	12, 498, 000	48, 513, 000	3, 322, 000	45, 191, 000	1.12
1872–'73	50, 905, 000	7, 127, 000	58, 032, 000	3, 226, 000	54, 806, 000	1.33
1873–'74	56, 460, 000	7, 779, 000	64, 239, 000	3, 593, 000	60, 646, 000	1.46
1874–'75	44, 108, 000	7, 218, 000	51, 326, 000	1, 651, 000	49, 675, 000	1.18
1875–'76	66, 581, 000	5, 672, 000	72, 253, 000	9, 004, 000	63, 249, 000	1.49
1876–'77	56, 800, 000	3, 354, 000	60, 154, 000	11, 618, 000	48, 536, 000	1.13
1877–'78	65, 456, 000	2, 369, 000	67, 825, 000	18, 009, 000	49, 816, 000	1.15
1878–'79	74, 060, 000	2, 112, 000	76, 172, 000	25, 627, 000	50, 545, 000	1.15
1879–'80	76, 875, 000	1, 730, 000	78, 605, 000	24, 399, 000	54, 206, 000	1.22
1880–'81	101, 164, 000	1, 481, 000	102, 645, 000	56, 496, 000	46, 149, 000	1.12
1881–'82	100, 351, 000	1, 518, 000	101, 869, 000	44, 992, 000	56, 877, 000	1.25
1882–'83	139, 955, 000	1, 730, 000	141, 685, 000	74, 398, 000	67, 287, 000	1, 47
1883–'84	142, 690, 000	1, 401, 000	144, 091, 000	96, 302, 000	47, 789, 000	1.04
1884–'85	166, 443, 000	1, 379, 000	167, 822, 000	128, 453, 000	39, 369, 000	.86
1885–'86	113, 125, 000	1, 435, 000	114, 560, 000	90, 068, 000	24, 492, 000	.53
1886–'87	141, 213, 000	1, 232, 000	142, 445, 000	108, 821, 000	33, 624, 000	.75
1887–'88	118, 387, 000	1, 858, 000	120, 245, 000	105, 568, 000	14, 667, 000	.31
1888–'89	108, 694, 000	1, 477, 000	110, 171, 000	80, 076, 000	30, 095, 000	.62

W. H. EDWARDS,
Consul General.

UNITED STATES CONSULATE-GENERAL,
Berlin, February 9, 1890.

GERMANY—1888.

REPORT BY CONSUL WAMER, OF COLOGNE.

In the hope that the sugar crisis in the campaign of 1885–'86 would soon come to an end the area of beets planted in 1887 was not very much larger than that cultivated in the preceding year, which had been reduced as much as possible in order to avoid an overproduction. The condition of the industry in the campaign of 1886–'87 did not turn out as it had been hoped it would, and so it was again thought necessary to reduce the production in the following campaign. In 1887 the manufacturers not only reduced their area, but also made smaller contracts with the farmers. The farmers, therefore, who raise beets for sale, that is, those who are not manufacturers themselves, planted less because they were unable any longer to realize the profits which they had hoped for. The production of beets in the campaign 1884–'85 amounted in tons to 10,402,688; campaign 1885–'86 to 7,070.316; campaign 1886–'87 to 8,306,671, and campaign of 1887–'88 to 6,963,960. The prices paid for beets in the last campaign ranged from 1.50 to 2.40 marks per 100 kilograms.

The technical improvements in the campaign of 1887–'88 in beet-sugar manufacture consisted in evaporation contrivances and filtering processes. The improvement in the first instance consisted in a greater saving in the use of waste steam by making the evaporation space larger and the heating of the apparatus more than formerly with indirect steam, whereby a material saving in heating fuel is accomplished. In the purifying of the beet juice sulphurous acid has been brought more into use; also, the repeating treatment of the juice with lime and carbonic acid, with the use of the filtering presses, has proved satisfactory. A new separation process, with the addition of carbonate of magnesia, is reported to have worked with good results in the Rhineland.

In the campaign of 1887–'88, there were 167 factories that prepared sugar from molasses against 137 in the preceding campaign, of which 84 worked by the "Osmose" process. As long as the prices of sugar were low and the price of molasses proportionately so, this process went largely out of use on account of too small profits, but it has been recommenced in the last year by a large number of factories, because the corresponding prices of sugar and molasses have been more favorable. In the campaign of 1886–'87, 55 factories worked with the "Osmose" process, 3 in 1885–'86, 79 in 1884–'85, 115 in 1883–'84, 124 in 1882–'83, and 135 in 1881–'82. In 1886–'87, 48 factories worked with the "Elution" process, 9 with the "Substitution," 3 with the "Precipitation," 20 with the "Separation," 3 with the "Strontium," and 1 with the "Manoury."

The following quantities of molasses were used for being converted into sugar by the above factories in the campaign of 1886–'87:

	Tons.
Osmose process	68,954
Elution and precipitation process	88,256
Substitution process	11,754
Separation process	39,889
Strontium process	6,341
All other processes	761
Total	215,955

The prices of sugar in the last campaign were more favorable in consequence of the prospect of a reduction in the production of beets, and of a smaller supply of sugar, on hand. In September and October there was a considerable sinking in the prices, but from that time they began to rise, when in January their highest points were reached. During the remaining period of the campaign, although the movement in the prices from February to May was downward, it took an upward course in June and July. The average prices of sugar in the principal markets of Germany per 100 kilograms during the last and preceding campaigns were as follows:

Campaign.	Refined sugar.			Raw sugar.		
	Brunswick.	Cologne.	Magdeburg.	Brunswick.	Cologne.	Magdeburg.
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
1887–'88	58.76	59.43	57.70	46.35	48.67	46.39
1886–'87	53.36	54.43	52.64	41.27	43.53	41.29

The annexed table of the production of beet sugar in Germany during the past 17 years shows what wonderful progress there has been made in this one industry in Germany. The number of factories in operation rose from 311 in 1871–'72 to 391 in 1887–'88, and the quantity of beets worked during the same period rose from 2,250,000 to near 7,000,000 tons. The largest quantity of beets worked during said period was in 1884–'85, which amounted to 10,500,000 tons. (See Table A.)

The exports of raw beet sugar from the German Zollverein rose from 5,666 tons in 1871–'72 to 553,793 tons in 1884–'85, which fell off to 344,710 tons in 1887–'88. The export bounties amounted in 1871–'72 to about $922,468, and in 1887–'88 to a little over $2,700,000. The total gross receipts of the taxes on sugar in 1871–'72, including the import duties, were $11,546,044, and in 1887–'88, $26,040,844. The net income, therefore, to the Government, that is, after deducting the bounty, was only a little above $1,000,000 in 1887–'88, against $10,625,000 in 1871–'72. The highest net income received by the Government during the 17 years was in 1882–'83, when it amounted to about $16,000,000.

Revenues from taxes on sugar beet collected in the Zollverein of Germany.

Years.	Gross receipts from sugar tax.	Gross receipts from import duty on sugar.	Total gross receipts from all taxes and duty.	Bounties on exports.	Net receipts from taxes and duties.	
					Total.	Per capita.
						Cents.
1880–'81	$24,077,024	$352,470	$24,429,494	$13,458,421	$10,971,073	28½
1881–'82	23,833,576	361,297	24,244,873	10,332,189	13,912,684	31
1882–'83	33,309,158	411,765	33,720,923	17,706,644	16,014,279	35½
1883–'84	33,960,239	333,314	34,293,553	22,919,935	11,373,618	25
1884–'85	39,613,436	328,107	39,941,543	30,571,741	9,369,799	20½
1885–'86	26,923,766	341,455	27,265,221	21,436,075	5,829,146	12½
1886–'87	33,608,791	293,161	33,901,952	27,175,207	6,726,745	14¼
1887–'88	28,176,253	442,135	28,618,388	27,040,844	1,577,544	3¼

Imports and exports of sugar in the German Customs Union.

Fiscal years.	Imports.				Exports.				
	Refined and raw sugar, Dutch standard, No. 19 and upwards.	Raw sugar below No. 19.	Sirup and dutiable molasses.	Molasses for distilleries.	Raw sugar, etc. (against drawback).	Candy sugar (against drawback).	Other hard sugar, etc. (against drawback).	Sugar without drawback.	Molasses and sirup.
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	127,305	315,832	73,298	81,341	56,665	41,763	16,328	19,394	8,563
1872–'73	124,886	97,562	69,323	23,716	81,777	51,331	28,472	8,043	35,559
1873–'74	161,483	84,148	61,021	50,422	118,092	41,120	26,310	21,182	79,363
1874–'75	141,010	89,133	56,587	50,335	28,838	39,452	15,359	16,531	79,829
1875–'76	145,273	24,526	48,397	4,748	458,942	47,125	25,329	19,588	84,588
1876–'77	77,097	10,172	53,189	28,600	462,189	73,935	43,423	9,857	122,624
1877–'78	49,153	11,674	41,028	7,054	712,010	140,013	83,416	6,764	148,744
1878–'79	39,012	15,304	38,329	31,827	1,034,718	193,561	113,966	2,243	174,507
1879–'80	29,831	16,764	28,996	72,369	915,616	252,364	97,052	2,073	171,576
1880–'81	22,654	12,652	33,220	48,510	2,214,420	353,787	206,814	1,056	160,782
1881–'82	22,016	15,049	33,139	4,588	2,539,310	399,160	144,130	615	211,183
1882–'83	21,038	23,705	35,369	3,611	3,907,027	493,811	242,181	646	141,473
1883–'84	15,577	18,763	32,216	1,695	4,911,761	642,469	298,679	597	255,381
1884–'85	12,645	20,668	33,372	2,816	5,537,931	760,154	318,852	403	650,618
1885–'86	12,300	26,203	28,942	.....	4,040,715	660,196	205,689	365	511,206
1886–'87	14,618	15,675	27,166	1	4,896,801	1,303,789	238,828	414	245,094
Average...	63,494	49,864	43,350	25,727	1,997,051	343,377	131,552	6,861	195,094

WM. D. WAMER, *Consul.*

UNITED STATES CONSULATE,
Cologne, February 23, 1890.

GERMANY—1888.

REPORT OF COMMERCIAL AGENT SMITH, OF MAYENCE.

The beet-root crop amounted to less than in the preceding year. On the first of August of the past year the new sugar law went into effect, by which the tax upon roots was reduced from 1.70 marks (42 cents) per hundred kilograms (220 pounds) to 80 pfennigs (20 cents), and the export drawback allowed, from 17.25 marks ($4.31) a hundred kilograms of raw sugar having at least 90 per cent. of polarization to 8.50 marks

($2.12), and a new consumption tax of 12 marks ($3) a hundred kilograms introduced on sugar of all kinds consumed in the Empire. This latter tax, it is thought, will yield the Government about $12,000,000 on about 4,000,000 double centners of sugar (a double centner is 221 pounds), which is about the amount consumed in the empire. The export bounty is 8.50 marks ($2.12) on raw sugar containing at least 90 per cent. of sugar, 10 marks ($2.50) on refined sugar containing at least 90 per cent. of sugar and not more than 98 per cent., and 10.55 marks ($2.63) on sugar containing at least 99½ per cent. of sugar.

In 1868 a law was passed fixing a tax on beet roots and providing for a drawback on exported sugar. At that time it took 12½ hundred-weight of beet roots to give 1 hundred-weight of sugar, and on this basis the tax was imposed, so as to give the government 10 marks ($2.50) on each hundred-weight of sugar; and on the sugar when exported a drawback of 9.40 marks ($2.35) was allowed. This afterward turned out to be a very advantageous arrangement for the sugar-manufacturers, as improved processes of manufacture took place by which 1 hundred-weight of sugar was obtained from 9 hundred-weight of roots, and sugar was even got from molasses, which the law of 1868 did not tax at all. The sugar-manufacturers, therefore, instead of paying a tax of 10 marks ($2.50), as contemplated by law, paid only 7.80 marks ($1.95) a hundred weight, and on exporting the sugar got a drawback of 9.40 marks ($2.35) a hundred-weight, thus receiving a nice bounty. All this was very fine for the manufacturers, but very disadvantageous to the imperial exchequer. In 1883, and again in 1886, an effort was made to regulate the matter somewhat by laws passed in those years; but the knife was not sufficiently well applied, and it became necessary to pass still another law on the subject, which went into effect on the 1st of August, 1888.

On the sugar consumed in the empire, say about 3,500,000 double centners annually, the government received a tax of about $15,000,000, to collect which cost about $1,500,000, and the actual loss to the imperial exchequer by the drawback allowed on exported sugar amounted to about $9,000,000 to $9,500,000. Thus the government got from the sugar tax in net receipts only $3,500,000 to $4,500,000. The lion's share went in indirect bounty to the manufacturers. Under the present law the manufacturers will still get an export premium of about 2½ marks per double centner, or about $4,000,000 for the whole amount annually exported.

J. H. SMITH,
Commercial Agent.

COMMERCIAL AGENCY,
Mayence, January 12, 1889.

GERMANY—1888.

REPORT BY CONSUL FALKENBACH, OF BARMEN.

Many things which were formerly counted articles of luxury have now entered into general and daily use and are reckoned as indispensable to life and comfort. This is due to the great change which has come over our habits and customs. As the relations between the different countries and people of the world have become more intimate and their means of communication speedier, competition in international trade and commerce has grown sharper and more active. A wider theoretical knowledge and a profounder technical skill have come to the assistance of labor. The products of labor have been thereby cheapened, the cost of living consequently reduced, while hand in hand with the increased consumption there has been an unprecedented increase of production. This is particularly the case with sugar.

SUGAR PRODUCTION AND CONSUMPTION.

At the beginning of the last century the supply of sugar in Europe scarcely equaled half a million meter centners.* In 1730 the import of this article to Europe was estimated at a little over a million meter centner. To-day the annual consumption of raw sugar in England alone amounts approximately to 11,000,000 meter centners. According to authentic sources, moreover, in the year 1867, the total annual production of colonial sugar (cane sugar) amounted to 14,000,000 meter centners, while at present it reaches far above 30,000,000. Of beet sugar, the annual production of which was at one time only 3,500,000 meter centners, 25,000,000 meter centners are now annually consumed. In the saccharine constituents of the native German sugar beet, cane sugar, formerly exclusively used, has found a mighty competitor.

It is from the sugar cane, *Saccharum officinarum*, that the major portion of the world's supply of sugar is obtained. The American continent, with its adjacent islands, constitutes undoubtedly the most productive source, while the Island of Cuba is the largest sugar-growing country in the world, having produced in 1849 about 220,000 meter tons; in 1859, 415,000 meter tons; in 1870, 660,000 meter tons; in 1881, 521,000 meter tons, and, in 1882, 606,000 meter tons. On the South American continent Brazil ranks first as a sugar-producing country, and, after Cuba, furnishes the largest supply of sugar cane. In the harvest of 1860–'61 Brazil exported rather more than 650,000 meter centners, and in 1876–'77 as much as 1,800,000 meter centners. Since 1879, notwithstanding various circumstances, which tended to paralyze the trade, the export of sugar from Brazil has averaged more than 2,000,000 meter centners. In the extraordinary good harvest year of 1880–'81 it rose to over 2,500,000 meter centners, and in 1881–'82, in

*A meter centner is equal to 110 pounds.

which year the sugar-cane harvest was generally unfavorable, equaled, quite unexpectedly, 2,200,000 meter centners.

The following comparative estimate shows the present average production of colonial sugar in all sugar-growing countries. Owing to unavoidable circumstances the figures are in some instances only approximate:

	Meter centners.
Cuba (production)	6,000,000
Brazil (export)	2,500,000
British West Indies (export)	1,800,000
United States of America (production)	1,500,000
French West Indies (production)	950,000
British Guiana (export)	850,000
Peru (production)	630,000
Venezuela (production)	420,000
Argentine Republic (production)	230,000
Dutch Guiana (export)	140,000
San Domingo (production)	63,000
Mexico (export)	40,000
San Salvador (export)	25,000
British Honduras (export)	25,000
Nicaragua (export)	5,000
French Guiana (production)	2,000
Total in America	15,180,000
Java (production)	2,500,000
China (production)	2,500,000
Philippine Islands (export)	2,000,000
British East Indies (export)	330,000
Siam (export)	18,000
Total in Asia	7,348,000
Hawaii (export)	300,000
Queensland (production)	210,000
New South Wales (production)	90,000
Fiji Islands (production)	10,000
Total in Australia and Polynesia	610,000
Mauritius (production)	1,350,000
Réunion (production)	320,000
Egypt (production)	430,000
Natal (export)	120,000
Mayotte (production)	40,000
Nossi Bé (production)	20,000
Total in Africa	2,280,000
Spain	380,000
Total in Europe	380,000

The total production of colonial sugar in the world amounts, therefore, to 25,689,000 metre centners. To this amount, however, must be added, first, the cane sugar produced in countries other than those

above mentioned; and secondly, the home consumption of cane sugar in places from which the export has alone been stated. The total amount of sugar produced from sugar cane may then be reckoned at considerably more than 25,000,000 metre centners; in fact, a total of 26,000,000 to 27,000,000 could not be regarded as an exaggerated estimate.

Great, however, as the importance and growth of the sugar-cane industry as shown by the above figures most undoubtedly are, the vastness of the increase in the consumption of sugar by all nations during the past 20 years is first seen when a comparison is made between the development of beet sugar and that of colonial sugar as articles of commerce.

Professor Achard, a pupil of the highly meritorious discoverer of the new method of beet-sugar manufacture, Professor Markgraf, of the Berlin University, whose death occurred in 1782, started on his farm "Cunern," in Lower Silesia, at the turn of the past and present century, with the aid of and under the protection of Frederic William III, the then reigning king of Prussia, the first beet-sugar factory in Europe. The new industry, however, owing to various causes, did not begin to flourish until much later. France, in fact, which had in 1837 no less than 585 beet-sugar factories, producing 50,000 metre centners of beet sugar annually, was the first country in which the industry in question can be said to have struck firm root. Germany followed slowly in the wake of her neighbor. In 1837 she had only 122 beet-sugar factories in operation with an annual production of only 14,400 metre centners of sugar from 254,000 metre centners of beets.

New, and almost exclusively European, the beet sugar industry supplied the world's market in 1882–'83 with 21,455,340 metre centners of sugar; in 1883–'84 with 22,400,000 meter centners, and in 1886–'87 with approximately 23,672,000 metre centners, or scarcely 14 per cent. less than the old colonial sugar industry, which is distributed over the tropic and temperate zones of the whole earth.

At the present date the beet-sugar production amounts in metre tons, at 1,000 kilograms, to—

Countries.	1876-'77.	1881–'82.	1882–'83.	1883–'84.	1884–'85.	1885–'86.	1886–'87.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
In Germany	289, 422	599, 722	848, 124	925, 000	1, 123, 030	808, 100	985, 600
In Austria-Hungary	341, 553	411, 015	472, 002	435, 000	450, 000	475, 000	460, 600
In France	243, 182	393, 269	423, 194	450, 000	475, 000	460, 000	465, 000
In Russia and Poland	250, 000	308, 779	284, 491	300, 000	320, 000	315, 000	320, 000
In Belgium	45, 628	73, 136	82, 723	90, 000	92, 000	90, 000	93, 000
In Netherlands	16, 078	20, 000	25, 000	30, 000	35, 000	32, 000	35, 000
In other countries	10, 000	10, 000	10, 000	10, 000	10, 000	10, 000	10, 000
Total production	1, 195, 563	1, 815, 921	2, 145, 534	2, 240, 000	2, 505, 030	2, 190, 100	2, 369, 200

These figures, however, only show the extensive development of the beet-sugar industry, and not the more important development, which must certainly be considered as the true cause of the enormous increase in the consumption of beet-sugar.

GERMAN BEET-SUGAR PRODUCTION.

This intensive development is shown in the following table, extracted from the official statistics of the German Empire on beet-sugar manufacture:

Statistics of the average production of sugar and molasses during the years 1836 *to* 1887.

During the year.	No. of factories.	Annual average amount of beets consumed.		Production of raw sugar (juice reduced to raw sugar).	Production of—		Beets consumed per m. c. raw sugar.	Average production of—	
		In all factories generally.	Per factory.		Molasses.	Raw sugar per factory.		Raw sugar.	Molasses.
		Met. cwt.	*Met. cwt.*	*Met. cwt.*	*Met. cwt.*	*Met cwt.*	*Met.cwt*	*Per cent.*	*Per cent.*
1836–'37.	122	353, 500	2, 100	14, 100	10, 900	115, 500	18. 00	5. 50	4. 30
1840–'45.	116	2, 067, 700	17, 800	129, 900	70, 400	1, 119, 500	15. 91	6. 30	3. 38
1845–'55.	221	9, 238, 900	41, 800	701, 800	233, 700	3, 125, 500	13. 66	7. 57	2. 54
1860–'65.	253	17, 931, 800	70, 900	1, 424, 400	402, 000	5, 129, 500	12. 50	8. 00	2. 23
1870–'75.	322	29, 530, 600	91, 700	2, 512, 400	840, 800	7, 802, 500	11. 75	8. 53	2. 96
1875–'76.	332	41, 612, 800	125, 300	3, 580, 500	1, 389, 500	10, 314, 500	11. 62	8. 60	3. 22
1878–'79.	324	46, 287, 400	141, 800	4, 261, 500	1, 336, 500	13, 152, 500	10. 86	9. 21	2. 80
1880–'81.	333	63, 222, 000	184, 300	5, 559, 100	1, 649, 800	16, 694, 000	11. 37	8. 80	2. 69
1881–'82	343	62, 719, 500	182, 900	5, 997, 200	1, 508, 100	17, 484, 600	10. 46	9. 56	2. 40
1882–'83.	358	87, 471, 500	244, 300	8, 319, 900	1, 963, 100	23, 826, 200	10. 47	9. 51	2. 24
1883–'84.	376	89, 181, 300	237, 200	9, 401, 000	2, 079, 700	25, 002, 900	10. 54	10. 54	2. 33
1884–'85.	408	104, 026, 800	254, 900	11, 230, 300	2, 596, 900	27, 532, 600	10. 79	10. 79	2. 50
1885–'86.	379	70, 703, 100	177, 200	8, 081, 400	1, 801, 700	19, 587, 660	11. 03	11. 43	2. 55
1886–'87.	401	83, 066, 700	207, 100	9, 856, 200	2, 158, 800	24, 579, 200	11. 86	11. 87	2. 60

According to these figures the quantity of beets requisite to produce one metre centner of raw sugar has declined in the German Customs Union since 1836 by 40 per cent.; in the case of the less valuable molasses by 45 per cent, while the gain in raw sugar has risen by 75 per cent. The efficiency of the individual factories in producing raw sugar has increased by 20.202 per cent., and the total production by 59.2 per cent. The superior yield of saccharine matter from the beets is attributed only in a small degree to the larger average intrinsic quantity of sugar gradually produced by rational culture in the beets consumed. It is far more the result of the scientific and technical improvements which have been introduced in the internal economy of the sugar factories.

The enterprise which the Germans have shown in their application of science and new technical processes in the manufacture of beet sugar is shown by the following facts and statistics:

In the German Empire were operated in the years—

1871–'72, in a total of 311 factories, 52 with diffusion, 259 with presses.

1875–'76, in a total of 332 factories, 157 with diffusion, 175 with presses.

1882–'83, in a total of 358 factories, 343 with diffusion, 15 with presses.

1886–'87, in a total of 401 factories, 397 with diffusion, 4 with presses.

In 1886–'87, 401 sugar factories were in operation in Germany, while a large additional number were either planned or in course of construction. No less than 147,782 hectares of land were appropriated to the cultivation of beets (1 hectare equals 2.471 acres), the average crop being 300 meter centners to the hectare. The production of raw sugar

amounted to 9,856,278 meter centners, that of molasses to 2,158,872 meter centners, or 12,015,150 meter centners of salable produce.

Germany exported in 1886–'87 : Raw sugar, 5,136,039 meter centners, valued at 188,234,829 marks; refined sugar, 1,303,789 meter centners, valued at 101,043,649 marks; sirup and molasses, 243,508 meter centners, valued at 2,725,138 marks; total beet-sugar produce export, 6,685,336 meter centners, valued at 292,003,616 marks. The value of the export in 1882 was 156,770,000 marks, and in 1881, 151,898,000 marks, so that from 1881 to 1882 an increase of 4,897,000 marks took place, and from 1881 to 1887 an increase of 140,105,616 marks. The principal portion of the beet sugar manufactured in Germany is exported to England. At the same time it is probable that a portion of the English import stated as of German origin may have come from Germany only in transit. Nevertheless the German sugar industry most undoubtedly dominates the English market. In fact Germany, with her present annual production of 9,856,200 meter centners of raw sugar, is without doubt the chief sugar-producing country in the world.

During the past few years great efforts have been made to develop the beet-sugar industry in the United States. The experiments, however, which have been made at a vast sacrifice of energy and capital, have entirely failed. This deplorable experience, so dearly purchased, is partly due to the insufficient supply of beets, inferior apparatus, and mismanagement.

The following tables, A, B, C, and D, compiled from the official statistics of the German Empire for the beet-sugar industry, give a clear and very comprehensive idea of its vast extent and profitableness.

TABLE A.—*Number, arrangements, and days' work of the sugar factories in the German Customs Union, extraction and manufacturing of raw material, during the fiscal years* 1871–'72 *to* 1886–'87.

Fiscal year.	No. of factories.	Run with steam engines.		Factories extracting the juice—			Amount of sugar beets consumed.		
		No.	Total horse-power.	With diffusion.	With presses.	With other operations.	Own produce.	Purchased.	Total consumption.
1	2	3	4	5	6	7	8	9	10
							100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	311	1,921	18,162	52	216	43	15,043,510	7,465,762	22,509,182
1872–'73	324	2,076	19,923	63	220	41	21,012,014	19,802,494	31,815,508
1873–'74	337	2,203	21,954	80	214	43	24,209,086	11,078,553	35,287,637
1874–'75	333	2,233	22,712	113	181	39	19,080,947	8,486,504	27,567,451
1875–'76	332	2,300	23,325	157	137	38	28,363,068	13,249,774	41,612,842
1876–'77	328	2,370	24,923	197	98	33	24,901,537	10,598,829	35,500,366
1877–'78	329	2,413	25,788	224	81	24	28,727,752	12,181,928	40,909,680
1878–'79	324	2,493	26,882	258	50	16	31,140,298	15,147,179	46,287,477
1879–'80	328	2,627	29,586	291	28	9	28,505,861	19,546,754	48,052,615
1880–'81	333	2,812	32,269	309	20	4	38,716,787	24,505,243	63,222,030
1881–'82	342	3,046	35,476	324	16	3	34,317,535	28,401,944	62,719,479
1882–'83	358	3,365	40,515	343	12	3	44,486,319	42,985,219	87,471,537
1883–'84	376	3,715	46,158	368	6	2	42,050,639	47,130,664	89,181,303
1884–'85	408	4,196	56,119	402	4	2	49,362,459	54,664,424	104,026,883
1885–'86	399	4,188	57,194	395	3	1	41,990,474	28,712,694	70,703,168
1886–'87	401	4,276	58,770	397	3	1	44,360,835	38,705,877	83,066,712
Average of 16 years	348	2,890	33,735	248	81	19	32,266,883	23,353,984	55,620,867

TABLE A.—*Number, arrangements, and days' work of the sugar factories, etc.*—Continued.

Fiscal year.	Proportion of purchased crop beets to total consumption.		Area of own crop.	Beets raised per hectare.	Days of 12 hours in which beets were consumed.	Beets consumed per day of 12 working hours.
1	11	12	13	14	15	16
	Per ct.	*Per ct.*	*Hectares.*	100 *ks.*		100 *ks.*
1871–'72	66.8	33.2	73,690	204	64,451	349
1872–'73	66.0	34.0	82,590	254	87,677	363
1873–'74	68.6	31.4	88,877	272	91,254	387
1874–'75	69.2	30.8	92,655	206	70,020	394
1875–'76	68.2	31.8	96,724	293	91,675	454
1876–'77	70.1	29.9	98,725	252	70,608	503
1877–'78	70.2	29.8	104,723	274	75,320	543
1878–'79	67.3	32.7	107,679	289	75,895	610
1879–'80	59.3	40.7	113,003	252	70,909	678
1880–'81	61.2	38.8	118,431	327	82,052	771
1881–'82	54.7	45.3	121,256	283	76,325	822
1882–'83	50.9	49.1	129,262	344	94,816	923
1883–'84	47.2	52.8	140,843	299	89,956	991
1884–'85	47.5	52.5	150,077	329	97,065	1,072
1885–'86	59.4	40.6	138,869	302	65,642	1,077
1886–'87	53.4	46.6	147,782	300	72,593	1,144
Average of 16 years	58.0	42.0	112,828	286	79,766	697

TABLE B.—*Business results of the sugar factories in the German Customs Union.*

Fiscal years.	Taxed sugar beets (Table A, column 10) produced.			
	Juice.	Out of juice (column 2).		
		Raw sugar.	Molasses.	Total salable produce (columns 3 and 4).
1	2	3	4	5
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	2,629,931	1,864,419	638,917	2,503,336
1872–'73	3,716,170	2,625,511	915,887	3,541,398
1873–'74	4,121,142	2,910,407	1,058,183	3,968 590
1874–'75	3,680,442	2,564,124	976,028	3,540,152
1875–'76	5,028,183	3,580,482	1,339,524	1,920,006
1876–'77	4,055,036	2,894,227	1,111,011	4,005,238
1877–'78	5,155,951	3,780,091	1,228,128	5,008,219
1878–'79	5,761,803	4,261,551	1,336,515	5,598,066
1879–'80	5,544,094	4,094,152	1,313,709	5,407,861
1880–'81	7,393,360	5,559,151	1,649,842	7,208,993
1881–'82	7,740,044	5,997,222	1,508,129	7,505,351
1882–'83	10,935,556	8,319,953	1,963,047	10,283,000
1883–'84	12,168,794	9,401,093	2,079,781	11,480,874
1884–'85	14,486,187	11,230,303	2,596,997	13,827,300
1885–'86	10,257,772	8,081,049	1,801,775	9,882,824
1886–'87	12,459,832	9,856,278	2,158,872	12,015,150
Average of 16 years	7,195,894	5,438,751	1,479,771	6,918,522

TABLE B.—*Business results of the sugar factories, etc.*—Continued.

Fiscal years.	Produced out of 100 kilograms taxed sugar beets.				Produced out of 100 kilos of juice.		Beets consumed to manufacture 100 kilos raw sugar.
	Juice.	Raw sugar.	Molasses.	Total salable produce (columns 7 and 8).	Raw sugar.	Molasses.	
1	6	7	8	9	10	11	12
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	10⁰ *kilos.*
1871–'72	11.68	8.28	2.84	11.12	70.89	24.29	12.87
1872–'73	11.68	8.25	2.88	11.13	70.65	24.65	12.11
1873–'74	11.68	8.25	3.00	11.25	70.62	25.68	12.12
1874–'75	13.35	9.30	3.54	12.84	69.67	26.52	10.75
1875–'76	12.08	8.60	3.22	11.82	71.21	26.64	11.62
1876–'77	11.42	8.15	3.13	11.28	71.37	27.40	12.27
1877–'78	12.60	9.24	3.00	12.24	73.32	23.82	10.82
1878–'79	12.45	9.21	2.89	12.10	73.96	23.20	10.86
1879–'80	11.54	8.52	2.73	11.25	73.85	23.70	11.74
1880–'81	11.69	8.79	2.61	11.40	75.19	22.32	11.37
1881–'82	12.34	9.56	2.40	11.96	77.48	19.48	10.46
1882–'83	12.50	9.51	2.24	11.75	76.08	17.95	10.51
1883–'84	13.65	10.54	2.33	12.87	77.25	17.09	9.49
1884–'85	13.93	10.79	2.50	13.29	77.52	17.93	9.26
1885–'86	14.51	11.43	2.55	13.98	78.78	17.56	8.75
1886–'87	15.00	11.87	2.60	14.47	79.10	17.33	8.43
Average of 16 years	12.94	9.78	2.66	12.44	75.58	20.56	10.23

TABLE C.—*Imports and exports of sugar in the German Customs Union.*

Fiscal years.	Imports.				Exports.				
	Refined and raw sugar, Dutch standard, No. 19 and upwards.	Raw sugar below No. 19.	Sirup and dutiable molasses.	Molasses for distilleries.	Raw sugar, etc. (against drawback).	Candy sugar, (against drawback).	Other hard sugar, etc. (against drawback).	Sugar without drawback.	Molasses and sirup.
1	2	3	4	5	6	7	8	9	10
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*
1871–'72	127,305	315,832	73,298	81,341	56,665	41,763	16,328	19,394	8,563
1872–'73	124,886	97,562	69,323	23,716	81,777	51,331	28,472	8,043	35,559
1873–'74	161,483	84,148	61,021	50,422	118,092	41,120	26,310	21,182	79,363
1874–'75	141,010	89,133	56,587	50,335	28,838	39,452	15,359	16,531	79,829
1875–'76	145,273	24,526	48,397	4,748	458,942	47,125	25,329	19,588	84,588
1876–'77	77,097	10,172	53,189	28,600	462,189	73,935	43,423	9,857	122,624
1877–'78	49,153	11,674	41,028	7,054	712,010	140,013	83,416	6,764	148,744
1878–'79	39,012	15,304	38,329	31,827	1,034,718	193,561	113,966	2,243	174,507
1879–'80	29,831	16,764	28,996	72,369	951,616	252,364	97,052	2,073	171,576
1880–'81	22,654	12,652	33,220	48,510	2,214,420	353,787	206,814	1,056	160,782
1881–'82	22,016	15,049	33,139	4,588	2,539,310	399,160	144,130	615	211,183
1882–'83	21,038	23,705	35,369	3,611	3,997,027	493,811	242,181	646	141,473
1883–'84	15,577	18,763	32,216	1,695	4,911,761	642,469	298,679	597	255,381
1884–'85	12,645	20,668	33,372	2,816	5,537,931	760,154	318,852	403	650,618
1885–'86	12,300	26,203	28,492	.....	4,040,715	660,196	205,689	365	551,206
1886–'87	14,618	15,675	27,166	1	4,896,801	1,303,789	238,828	414	245,094
Average in 16 years ..	63,494	49,864	43,350	25,727	1,997,051	343,377	131,552	6,861	195,094

TABLE D.—*Sugar consumption and revenue from sugar duties in the German Customs Union.*

Fiscal years.	Production of raw sugar.	Imports of sugar reduced to raw sugar.	Total production and imports.	Exports of sugar reduced to raw sugar.	Consumption of sugar computed to raw sugar.	
					Total (column 4 and 5).	Per head population.
1	2	4	3	5	6	7
	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	100 *kilos.*	*Kilos.*
1871–'72	1,864,419	496,332	2,360,751	142,757	2,217,994	5.5
1872–'73	2,625,511	270,852	2,896,363	179,382	2,716,981	6.6
1873–'74	2,910,407	289,530	3,199,937	216,550	2,983,387	7.2
1874–'75	2,564,124	276,907	2,841,031	108,134	2,732,897	6.5 — 6.5
1875–'76	3,580,482	212,532	3,793,014	561,209	3,231,805	7.6
1876–'77	2,894,227	125,060	3,019,287	603,538	2,415,749	5.6
1877–'78	3,780,091	88,830	3,868,921	967,785	2,901,136	6.7
1878–'79	4,261,551	79,710	4,341,261	1,380,768	2,960,493	6.7
1879–'80	4,094,152	65,842	4,159,994	1,344,857	2,815,137	6 3 — 6.6
1880–'81	5,559,151	56,073	5,615,224	2,839,039	2,776,185	6.8
1881–'82	5,997,222	57,330	6,054,552	3,144,103	2,910,449	6.4
1882–'83	8,319,953	66,012	8,385,965	4,725,514	3,660,451	8.1
1883–'84	9,401,093	53,761	9,454,854	5,958,144	3,496,710	7.7
1884–'85	11,230,303	53,035	11,283,338	6,737,274	4,546,064	9.9 — 7.9
1885–'86	8,081,049	55,745	8,136,794	5,003,215	3,133,579	6.8
1886–'87	9,856,278	46,779	9,903,057	6,611,280	3,291,777	7.0
Average in 16 years	5,438,751	143,395	5,582,146	2,532,722	3,049,424	7.0

Fiscal years.	Internal revenue.					
	Taxes on beet sugar.	Duties of entry.	Total revenue.	Drawbacks on exports.	Net revenue.	Per head of population.
1	8	9	10	11	12	13
	Marks.	*Marks.*	*Marks.*	*Marks.*	*Marks.*	*Marks.*
1871–'72	36,014,691	12,498,225	48,512,916	3,875,916	44,637,000	1.11
1872–'73	50,904,813	7,127,469	58,032,282	3,201,150	54,831,132	1.33
1873–'74	56,460,222	7,778,976	64,239,198	3,595,569	60,643,629	1.46
1874–'75	44,107,920	7,217,593	51,325,513	1,641,786	49,683,727	1.18
1875–'76	66,580,546	5,672,131	72,252,677	8,888,608	63,364,069	1.49
1876–'77	56,800,570	3,353,926	60,154,496	11,389,541	48,764,955	1.14
1877–'78	65,455,491	2,369,082	67,824,573	17,855,173	49,969,400	1.15
1878–'79	74,059,961	2,111,772	76,171,733	25,359,970	50,811,763	1.16
1879–'80	76,875,459	1,729,536	78,604,995	24,141,395	54,463,600	1.23
1880–'81	101,163,969	1,480,067	102,644,936	56,547,988	46,096,948	1.12
1881–'82	100,351,163	1,518,056	101,869,219	43,412,561	56,456,658	1.29
1882–'83	139,954,448	1,730,108	141,684,556	74,397,666	67,286,890	1.49
1883–'84	142,690,084	1,400,481	144,090,565	96,302,249	47,788,316	1.05
1884–'85	166,443,012	1,378,602	167,821,614	128,452,707	39,368,907	.86
1885–'86	113,125,068	1,434,687	114,559,755	90,067,544	24,492,211	.53
1886–'87	131,213,410	1,231,770	142,445,180	114,181,546	28,263,634	.60
Average in 16 years	89,512,552	3,752,086	93,264,638	43,956,961	49,307,677	1.13

JOSEPH FALKENBACH, *Consul.*

UNITED STATES CONSULATE,
Barmen, April 27, 1888.

GERMANY—1890.

REPORT BY CONSUL-GENERAL EDWARDS, OF BERLIN.

As throwing light on the systematic methods employed in Germany for the purpose of increasing the percentage of sugar in sugar beets, the following translation of the Hadmersleben Sugar Factory's instructions to beet-farmers may be found of interest:

INSTRUCTION AS TO THE CULTIVATION OF BEETS FOR THE HADMERSLEBEN SUGAR FACTORY.

SEC. 1. Every stockholder is bound each year, on the 15th of September at latest, to deliver to the superintendents of the factory a specification of that area of ground on which he purposes to plant sugar beets for the stock company in the following year, in conformity with his obligation, according to the number of his shares. The specification must contain exact information as to the position, area, manured condition, and series of crops during the three preceding years. The beets must not be planted on moist, moor, or saltpeter land, or on land which, within the preceding years, has been devoted to clover, esparcet, or lucern. Fresh-broken land (within the first five years) must not be devoted to beet-culture.

Further, the cultivation of sugar beets is forbidden in the first year after lying fallow and also after oil-producing crops, pulse, all kinds of cabbage and similar vegetables, and all vegetables which did not come to maturity in the preceding year and for two years after cess water has been used.

The superintendents must give notice to each stockholder, by the 1st of November at latest, as to whether or not the ground offered has been accepted; and, if not accepted, the reasons for the rejection, which must be based upon the above requirements, are to be given.

The stockholder in question, instead of the rejected land, has to offer other acceptable land, until the required amount has been supplied.

SEC. 2. The superintendents and inspectors examine the condition and extent of land offered for beet-culture and the specifications given by the stockholders, and oversee the planting, cultivation, and delivery of the beets. They have the power to satisfy themselves in every practical way and even to remeasure the land, if they see fit. Should it transpire that a stockholder has given inaccurate information he will be obliged to pay the costs incurred in proving the deception.

SEC. 3. Fertilizing with iron shavings, salt, and potassic salt is forbidden; but it is permitted to manure belt land with at most 120 centners of animal dung per morgen (acre), in case it is plowed under before December 31, or later, if the manure was applied at the proper time.

In artificial manures the ratio of nitrogen to phosphoric acid in solution must be 1 to 1.

The use of not more than 2 centners of Chili saltpeter per morgen is permitted.

It is forbidden to use more than 40 (German) pounds of nitrogen per morgen.

Where stable manure is used, 12 per cent. extra of phosphoric acid in solution is to be added.

Placing manure on the plants is forbidden.

Every stockholder is further bound to plant his beets before May 15, and, after that date, can do so only in exceptional cases and with the consent of the superintendents.

A second planting is permitted until June 1, but notice of the same must be given to the superintendents.

He is further bound to thin out the beets at the right time, to hoe at least three times and each time to hill; he must, moreover, devote the greatest possible industry to

the cultivation of the beets. On an average, the beets must be drilled not more than 14 inches apart and the plants left at intervals of not more than 12 inches. Before the harvest the plants must be robbed of no part of their leaves, and must be delivered at the factory clear, as far as possible, of leaves and earth and in such condition as to fill every requirement for the rational winning of sugar.

SEC. 4. The necessary beet seed are supplied by the factory to every stockholder—36 kilograms per hectare or 18 German pounds (half a kilogram) per morgen—free of charge. It is positively forbidden to use other seed. Every stockholder is, however, free, if he wishes, to drill more than 36 kilograms per hectare and to buy at cost price from the factory the desired extra quantity. The request must, however, be made to the superintendents early enough to allow them time to purchase the seed. This regulation applies also to where, for any cause, a second planting is necessary; and in such case, also, the stockholder must pay cost price for the seed.

SEC. 5. The superintendents determine, after making an estimate of the expected crop, what quantity of beets for the months of September and October each separate stockholder must deliver daily and weekly to the factory. Every stockholder is bound, by the 31st of October, with the greatest possible accuracy, to report to the directors (superintendents) the anticipated result of his beet crop.

On the basis of this result the superintendents issue a second notice as to the daily and weekly quantity of beets to be delivered by each stockholder.

Every stockholder is bound to comply with these requirements of the superintendents. The superintendents, however, may, in exceptional cases, make such allowances as the circumstances seem to demand.

SEC. 6. The total weight of beets delivered by wagon is to be decided by weighing on the factory scales. The total weight of beets delivered by railway is to be determined by weighing on the scales at the depot in Hadmersleben. The determining of the net weight, less the allowance for tops, dirt, etc., is left to the factory superintendents.

Against the decision of the factory superintendents the stockholder has the right of appeal to the directors. The decision of the directors is final.

The difference between the estimated net weight and the actually consumed taxed weight at the end of the business year is apportioned by percentage on all stock and other beets delivered and payments made accordingly.

SEC. 7. Every stockholder is bound to answer conscientiously every question put to him by the superintendents or inspectors.

SEC. 8. In case an actionary, or stockholder, does not comply in one or more points with these instructions, and especially if he plants beets on rejected land or makes untrue statements to the superintendents or inspectors or does not comply with the instruction in regard to the use of artificial manures, the superintendents may refuse the beets or may accept them at a lower price if they see fit.

The above rules as to the mode of culture insisted on apply, also, to other farmers not shareholders, the difference being that they receive less for their beets.

Great pains are taken in raising the seed for the factories, the object constantly in view being the increase in the percentage of sugar in the beet and the increase in the yield. Professor Maercker has, however, expressed the opinion that the improvement of the beet can not be pressed much further in the direction of increasing the sugar ingredient without endangering its productiveness. The object to be kept in view in the future, therefore, will be the evolution of a beet with the present high percentage of sugar and at the same time more productive.

As is well known, it takes two years to produce seed. In the first year choice seed are planted and beet roots grown. These roots are individually carefully examined and analyzed before being replanted in the second year to produce seed. The reliable seed-grower tests every single root and plants only such as are found to be especially rich in sugar.

When it is remembered that this systematic method of improving the beet root has been pursued for many years, the precautions taken by factory managers to compel the use of only such seed as have been delivered by themselves will be better understood.

W. H. EDWARDS,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, June 30, 1890.

GERMANY—1890.

REPORT BY CONSUL MERRITT, OF CHEMNITZ.

Sixteen millions of dollars is the sum of money, in round figures, which the United States sent to Germany to pay for beet sugar bought during the fiscal year ended June 30, 1890. Every pound of the sugar paid for by the $16,000,000 above mentioned was made from sugar beets grown in Prussia, in a latitude exactly on a line with the frozen regions of Labrador. There are within the United States, lying between the thirty-eighth and forty-second degrees of latitude, a great many millions of acres of land which are as thoroughly adapted to the culture of the sugar beet as any land on earth. The question naturally occurs to the mind of an American, why should the $16,000,000 paid for beet sugar be sent to Germany, instead of being paid to American agriculturists in the valleys of the Ohio, Mississippi, and Missouri Rivers? It is a subject of profound interest and has recently been considered by Congress as one of paramount national importance. It is a fact which no one will care to dispute that the United States is the greatest consumer of sugar in the world to-day. The consumption of sugar per capita per annum may be said to be as follows in five countries from which statistics are obtained: England, 60 pounds; United States, 44 pounds; France and Switzerland, 26 pounds; Germany, 18 pounds. Hence, with an enormous majority of population, the United States may be called the greatest sugar-consuming nation on earth.

EARLY NOTES ABOUT SUGAR.

One of the most interesting chapters in the history of every great invention or discovery is the recital of facts which show the enmity, obstruction, and incredulity which have had to be encountered and overcome before the world has been willing to accept the blessings and

benefits which progressive, enlightened, and scientific minds have placed within the reach and at the service of mankind. Well known, indeed, are the stories of the struggles which everywhere occurred when the potato was imported; the exasperating fanaticism manifested to check the spread of the use of tobacco; the innumerable statements made to prove the evil effects of the use of coffee, tea, and chocolate; not to mention the mad terror which seized on certain portions of the population when railways and other wonderful and splendid inventions were put in operation. But success was finally achieved and our race is bettered by it. Much less is known regarding the struggle through which sugar went or the misrepresentations and defamation which were hurled upon it before it rose from the position of a seldom-used and luxurious "salt" to be one of the most popular, necessary, and comfort-giving articles used in domestic economy.

The use of sugar in Europe was for long years most notably restricted. This entire portion of the globe was not consuming more than 1,500,000 metre centners per annum during the middle portion of the last century. The sale of sugar was a privilege of druggists in France until late in the seventeenth century. This monopoly did not tend to make the price of sugar cheap, as druggists in those days were not noted for low prices to any greater extent than they are at the present time; and it is doubtful if Scarron, the comedy writer, did not do his thrifty sister injustice when he accused her of stinginess because she made use of a sugar bowl with unusually small sifting holes in its top. With people who were not in independent circumstances sugar was at that time much more of a luxury than are champagne or truffles at the present time.

In his Physiology of Taste, published in 1800, Brillat-Savarin says:

> For more than 80 years the droll remark held good that the use of sugar injured a man only as far as related to his pocket book. Since then, however, the use of sugar has increased day by day until it has become so common that all well-to-do people spend annually more money for sugar than for bread.

Sugar was regarded with the greatest distrust. One declared that it overheated the system, another that it congested the lungs, others that it was a direct cause of apoplexy. Many natural philosophers of the seventeenth and part of the eighteenth century who were inexperienced in chemical and medicinal experiments passed severe sentence in erudite (?) discourse, endeavoring to show that sugar was altogether and utterly destitute of good qualities. Kunkel von Löwenstjern declared openly that sugar was, without doubt, injurious, because an experiment he had made sugar had accelerated fermentation, and hence sugar would bring the human body into a state of pernicious fermentation, accompanied by a host of stomach diseases. The equally well-known English scientist Boyle, discoverer of the composition of atmospheric air, arrived at a similar conclusion, particularly on account of his discovery that all sweet and farinaceous substances are susceptible of fermentation.

Garenzières had the courage or audacity in 1647 to make the monstrous declaration that sugar was not only not nutritious, but that—

> It is a poison; and no better deed can be done than send it back to India, from whence it came, because only by that action can consumption, which its immoderate use has developed, be checked.

Willis charges sugar with being responsible for about every ill that flesh is heir to, while Pauli charges that it heats the body inordinately, "to the imminent danger of inflamed lungs." Ray, Hermann, and Leméry attacked sugar from different directions, while, in conclusion, Beckmann, in his Supplement to the History of Great Discoveries, says that for doves, pigeons, lizards, frogs, and bees sugar is poison, but that for canary birds it is healthful, on account of which canary birds are called "sugar birds."

In all epochs and ages the war against sugar has been a "fight with windmills." And sugar, which was once treated with hostility and discredit, has taken its proper place in the front rank of human necessities and comforts. Its use and its production seem unlimited, for, while in 1876 the entire sugar product of the world was 31,000,000 meter centners, in 1884–'85 it had reached the enormous volume of 54,000,000 meter centners and has been increasing annually since then.

THE DISCOVERY AND DEVELOPMENT OF THE BEET-SUGAR INDUSTRY.

The earliest authentic record of beet sugar proves it to be a discovery of a learned German, Dr. Andreas Sigismund Marggraf, professor of chemistry and a member of the Berlin Academy of Sciences. He was born in Berlin March 3, 1709. In the records of the Berlin Academy of Sciences is a paper prepared by Dr. Marggraf detailing in full his discovery of sugar in beets, which was identical with that obtained from sugar cane. Dr. Marggraf discussed in his treatise the propriety of attempting to make beet sugar and sought to prove that profit could be derived from the undertaking. Among other things he said:

> It must be apparent, from the practical tests mentioned, that sugar can be as successfully made in this country as where the sugar-cane grows.

It is not of record that the learned Professor Marggraf pursued his researches further than the theoretical disclosures mentioned in his dissertation above alluded to; but a pupil of his, Franz Carl Achard, who became deeply interested in the subject, developed the idea of beet sugar making and proved that it could be done with profit. In 1799 Achard addressed a petition to Frederick William III, King of Prussia, and besought the patronage and protection of that monarch in the prosecution of beet-root-culture and the manufacture of beet sugar. Being finally persuaded of the merits of the discovery, the king subsidized the industry with $35,000. This fund was expended in the purchase of land in Lower Silesia, where, in 1801, a factory was built, and in the following year the process of making beet sugar began. Within a year

six other factories were started: one in Russia, two in France, and three in Prussia. Then came the Napoleonic wars; the development of the beet-sugar industry was for many years at a standstill. Achard was also the victim of a disastrous conflagration in 1809, which entirely destroyed his factory and machinery. Although heavily involved in debt, Achard had both faith and courage and set himself to work in the direction of rehabilitation. The king released him from the payment of the former loan and advanced him further financial aid, with which Achard founded a school for practical instruction in the industry of beet sugar. Fortune did not smile on him, however, and at the time of his death in 1821 Achard had not had an opportunity to see the industry to which he had consecrated the best years of his life in a flourishing and prosperous condition.

In France a factory was established on the Achard system at Lille by Crespel Delisse, whose untiring energy, great capability, and remarkable sagacity rescued the sugar-beet industry from depression and dissolution and placed it on a prosperous footing as one of the great and successful enterprises of the age. In 1830 Delisse was owner of several out of the hundred and more factories in operation and was recognized as a great authority and honest counselor in matters pertaining to the industry.

PRESENT CONDITION OF THE BEET-SUGAR INDUSTRY.

Subsequent to the time last mentioned the making of sugar from beets has made rapid progress. Scientific men have bent the best of their powers and energies to bring about methods of treating the vegetables and extracting the utmost saccharine from them and for the invention of improved machinery for diffusion, evaporation, and kindred uses. Flattering successes and triumphs have rewarded them. The results of philosophic experiments as to the quality of beets best adapted to certain conditions of soil and climate and the chemical researches which have been made for the purpose of discovering what fertilizers are the best have entirely covered these questions. The results of these exhaustive investigations have been made public and can be known by all.

The output of beet sugar from the many hundreds of factories in Europe for the "Kampaign" of August 1, 1889, to July 31, 1890, is one of the greatest ever known, and rivals the product of the cane-sugar districts of all parts of the world, both in quality and amount. The cost of production has been reduced to less than that of any former year. This is not attributable to a larger development of saccharine in the beets, but is the result of scientific and technical improvements in the management of the factories. Formerly it was calculated that 12½ pounds of beets were required to produce a pound of sugar; now sugar can be produced in proportions much more favorable. In the lowest estimate, 832 pounds of beets make 100 pounds of sugar, while the highest estimate requires only 10½ pounds of beets for a pound of sugar.

There are about thirty kinds of beets which are grown for the sugar factories of Germany. Each kind has some claim of special merit for special localities. Much depends on the kind of soil to be planted and in the selection of the beets to be sown. Among the most necessary elements in the successful cultivation of sugar beets are the richness of the beets in saccharine, the procuring of the seed from the most reliable sources, the proper preparation of the soil, the use of the most improved fertilizers, and the careful attention to and harvesting of the crops. A visit to the beet-growing districts will disclose that the best crops are obtained from a loose, sandy loam called a mild soil. The roots grow deep and require soil prepared fully 12 inches deep supplemented by a subsoil. Care is observed to avoid wet soil. Certain districts have certain regulations regarding the width between the rows and the distance between the beets in the rows. All are governed by fixed intervals, and it is stated that the nearer the beets grow together the more saccharine they contain, but the smaller they grow. On the better class of soils beets should be planted closer than on poorer soils if uniformity of size is desired. Growing of beets is decidedly beneficial to the soil and improves it for cereals. Crops should be reasonably alternated in order to rest the soil.

FUTURE OF BEET SUGAR IN THE UNITED STATES.

The future of beet sugar in the United States is problematical. It can not be gainsaid that the climate and soil of large portions of the States of Ohio, Indiana, Illinois, Missouri, Iowa, Kansas, Nebraska, Wisconsin, Minnesota, and many other districts are perfectly adapted to the culture of sugar beets. The Congress of the United States has recently taken novel and special action, which would give encouragement and protection to the enterprise should the American agriculturists embark in the beet-sugar industry. All machinery needed to convert the saccharine of beets into fine sugar is, by act of Congress, permitted to be imported free of duty from now on until the 1st day of July, 1892. A bounty of 2 cents per pound will be paid by the Government of the United States to the manufacturers of sugar for an indefinite period of time.

It is likely that the Government would do more. In Louisiana, on the Magnolia sugar plantation, owned by Ex-Governor Warmoth, lying some 40 miles south of New Orleans, on the Mississippi River, the United States has, within recent years, erected a magnificent experiment station in the interest of cane sugar production. The vast benefits of this station to sugar-growers can be relied upon to induce the Government at Washington to consider a proposition for the establishment of a similar station in the interests of a beet-sugar industry, should such an undertaking be entered upon by the farming community of our country, and the production of sugar from beets can be easily transferred to that belt of country so admirably adapted to its culture which

has been mentioned before. The information and experience gathered through all the costly experiments and mistakes which have been made and paid for during nearly a hundred years can be turned, without cost, to the benefit of our people, and profitable employment can be given to many thousands both winter and summer.

It would not be difficult to enter upon this industry at once. In order that all interested might share in the undoubted prosperity which would follow, the plan here submitted is modestly offered. A stock company, with a capital stock of $250,000 in 2,500 shares of $100 each, could be organized. Three-fifths of the shares could be made "beet shares" and two-fifths cash shares. Ten or 20 per cent. of the beet shares could be paid in cash, and the balance might be gradually deducted from the money due the shareholders for the beets delivered by them to their factory. The cash shares could be paid for in such manner as determined upon. The management of the concern is to be determined upon by the share-holders. This plan has been found to work with unqualified success in Germany, where many factories are in operation on this basis.

The bounty to be paid by the Government insures at least $4 per acre. Besides that small sum, the agricultural element will receive compensation for the beets raised, also a share of the residue from the beets after using, and which is very good fodder, and, what is of equal importance—in fact, the best of all—a share of the dividends. As has been heretofore stated, beet culture improves the soil, which is a consideration by no means to be underestimated nor overlooked.

In the beginning of this it is stated that the sum of $16,000,000 was paid by the people of the United States to the beet-sugar makers of Germany within one year. This sum is nearly three times as much money as our people paid for any other given article imported from Germany, cotton having come next with $6,000,000.

It does not seem proper nor consistent that an agricultural country like the United States should be dependent for any article of purely agricultural character on foreign countries, especially when the United States has fully one hundred times as much land adapted to the production of that article as is available in the country from whence the article comes.

It would be a matter of justice and equity, as well as of patriotism and profit, if the people of the United States (who have always treated, through their representatives, the people of all foreign nations with scrupulous fairness and with no wrongful discrimination against any) should convert some part of the vast domain now used for growing corn to fatten and nourish the splendid pork of our Western States into acres of sugar beets. In European beet-sugar countries American pork is forbidden entry.

H. F. MERRITT,
Consul.

UNITED STATES CONSULATE,
Chemnitz, October 25, 1890.

GERMAN SUGAR-BEET LEGISLATION.

REPORT BY COMMERCIAL AGENT WASHBURN, OF MAGDEBURG.

INTRODUCTION.

Two things have contributed to Germany's present ascendency in the production and exportation of raw beet sugar. The first is the superiority of soil and climate for the growing of the beet root; the second is the peculiar encouragement given the industry itself by the Government. It is to this latter factor that I wish to call attention in this report.

NATURE OF THE GERMAN TAX AND HOW IT WORKS.

The imposing of a tax on raw beets destined for the manufacture of sugar, with the accompanying rebate for the finished product when exported, is German in its origin, and is known as the "material tax," or "weight duty." This system presents no difficulties so long as the manufactured sugar goes into the home consumption, because the state treasury retains the amount of the tax in full. The moment, however, that the product is destined for the foreign market it imposes upon the customs authorities the responsibility of determining the exact amount of rebate to be granted. Though it is universally recognized that the effect of the present system is one of concealed bounties, the theory of the law is that of reimbursement. In other words, the Government contracts to return the amount of the tax upon all exported sugar, thus enabling the seller the better to compete in the world's market. To this end it is necessary to establish by law the estimated amount of raw beets required to produce a given quantity of sugar. Clearly, this will vary in different years and in different districts. An average rebate is therefore always sought. It thus happens that to those factories which work up beets rich in sugar and which have improved appliances the rebate comes, not as a reimbursement only, but as a bounty as well.

LEGISLATION, PAST AND PRESENT.

The history of recent sugar legislation is one of experiments, but all consistently tending towards one ultimate object—the suppression of the premiums. Prior to 1861 no rebate was allowed. The material tax pure and simple had, however, existed since 1844. The law of September 1 of that year placed the duty at 30 pfennigs* per 100 kilograms† of raw beets. This tax was steadily increased from time to time up to the passage of the present law, when it was materially modified.

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*1 mark of 100 pfennigs=23.8 cents. †1 kilogram=2.205 pounds.

The accompanying table shows the amount of tax per 100 kilograms from 1844 to 1891.

Period of enforcement.	Amount.	Period of enforcement.	Amount.
	Marks.		*Marks.*
September 1, 1844, to September 1, 1850..	0.30	September 1, 1869, to September 1, 1886.	1.60
September 1, 1850, to September 1, 1853..	0.60	September 1, 1886, to September 1, 1888.	1.70
September 1, 1853, to September 1, 1858..	1.20	September 1, 1888.....	0.80
September 1, 1858, to September 1, 1869..	1.50		

Law of 1869 *and its important results.*—In 1869 a thorough classification of the material tax and rebate took place. This law remained unchanged until 1883, and is regarded as having a more important bearing on the development of the beet-root industry than any other law which has been placed on the statute books. Its main provisions are here appended. It imposed a weight duty of 1.60 marks upon each 100 kilograms of raw beets. Upon home or foreign sugar exported beyond the customs frontier, the following rebate was granted per 100 kilograms: (1) For raw sugar of at least 88 per cent. polarization, 18.80 marks; (2) for candy and sugar in white, full, hard loaves up to 25 pounds net weight, or sugar crushed in the presence of the customs authorities, 23 marks; (3) for all other hard sugars, as well as for all white, dry (containing not less than 1 per cent. of water) sugar in crystals, crumbs, or flower form of at least 98 per cent. polarization, 21.60 marks. To receive the benefit of this drawback the amount exported must at least have reached 500 kilograms. Exportation could only take place through custom-houses indicated by the Bundesrath, and fines and penalties were attached for false declarations.

Two important results of this law are to be noted. Since the tax was imposed, not on the sugar itself but on the raw beets, farmers took great pains to increase the saccharine richness of the beets, and the manufacturers strove to devise more economical methods of extracting the sugar. What this means is most forcibly illustrated by a reference to recent French legislation. In 1884 it was estimated that it required about 17 tons of roots in France to produce a ton of sugar, as against 9½ tons in Germany for the same purpose. In that year the German material tax was adopted.

Its results are seen in the following table, which shows the quantity of raw beets required to produce a double centner* for the years 1884–'85 to 1889–'90, inclusive:

Year.	Quantity.	Year.	Quantity.
	D. centners.		*D. centners.*
1884–'85.....	15.02	1887–'88.....	9.44
1885–'86.....	11.42	1888–'89.....	9.16
1886–'87.....	10.15	1889–'90.....	8.56

*1 double centner = 100 kilograms.

For the current year, it is believed that the ratio will sink to 7.50 double centners of raw beets to 1 double centner of sugar.

Experimental legislation.—As a source of revenue, the law of 1869 was a failure. While under its fostering provisions the production of sugar was yearly increased, and with it the export trade, the receipts from the material tax showed no corresponding growth. Accordingly, measures looking to the modification of the law were initiated by the preliminary act of July 7, 1883. This act merely lowered the rebate scale and proposed further legislation in two years. In the meantime, in the autumn of 1883, a commission was appointed which examined carefully into all proposals relating to the taxing of sugar. Their recommendations were embodied in a report to the Reichstag in the early summer of 1884 (June 11). Following this, on May 13, 1885, the law of 1883, about to expire by time limit, was given another year's lease of life, that is, until August 1, 1886. This afforded opportunity for further investigation. The result was the law of July 1, 1886. This measure raised the material tax 10 pfennigs and still further lowered the rebate scale. It was hardly published before it was seen to be insufficient. A considerable bounty was still possible. Just what the bounty was I have not been able to learn. In a speech on July 9, 1884, the French minister of agriculture is reported to have said that it was equivalent to 3 francs per 100 kilograms on the whole crop and 7 francs on the amount exported.

Unsatisfactory results of the present law.—It becoming evident that no effectual reform could be had by adhering to the old system, a new principle more sweeping and radical in its provisions than anything hitherto attempted, was introduced into the law of July 9, 1887. This was the consumption tax, by which all sugars entering into home consumption were required to pay a certain duty. The old material tax on the beet root and the rebate were still retained, though both were reduced. This law, which is still in force, went into effect on August 1, 1888. The schedules were arranged as follows:

The material tax was fixed at 80 pfennigs per 100 kilograms. This was a reduction of 90 pfennigs.

The rebate per 100 kilograms was: (1) For raw sugar of at least 98 per cent. and for refined sugar containing less than 98 per cent., but at least 90 per cent., of sugar, 8.50 marks; (2) for candies and for sugars in white, full, hard loaves, blocks, plates, sticks, or cubes, or crushed in the presence of the revenue officers and for other sugars of at least 99½ per cent. purity which at any time may be classified by the federal council, 10.65 marks; (3) for all other hard sugar, as well as for all white, dry (not containing over 1 per cent. water) sugar in crystal, crumb, or flower form containing at least 98 per cent. sugar, so long as they do not fall under 2, 10 marks.

The actual workings of this measure, while yielding to the imperial treasury a larger income than was possible under the old system, do not seem to have met the expectations of its projectors. It seems to be re-

garded as a financial fiasco, and it is believed that handsome profits still accrue to the manufacturers.

The clear amount received by the Government from the sugar tax for the last five years, after deducting the managing expenses, which are reckoned at about 4 per cent., is:

	Marks.
1885–'86	16,932,822
1886–'87	13,510,145
1887–'88	21,270,284
1888–'89	47,298,681
1889–'90	60,369,848

An analysis of the receipts for the last two working years, during which time the additional consumption tax provided for by the new law has been in force, shows the following:

1888–'89.

	Marks.
78,961,830 double centners of raw beets were consumed, on which there was a material tax of 80 pfennigs per 100 kilograms	63,169,464
From this reimbursements were allowed:	
On 4,124,242 double centners of raw sugar at 8.50 marks	35,056,057
On 1,641,518 double centners of candies at 10.65 marks	17,482,167
On 156,506 double centners of crushed sugar at 10 marks	1,665,060
	54,103,284
	9,066,180
Deducting managing expenses at 4 per cent	2,526,779
Net receipts from the material tax	6,539,401
Net receipts from the consumption tax	40,759,280
Total income	47,298,683

1889–'90.

		Marks.
98,250,394 double centners of raw beets at 80 pfennigs		78,600,315
The reimbursements were:		
On 4,938,309 double centners of raw sugar at 8.50 marks	41,975,627	
On 2,157,366 double centners of candies at 10.65 marks	22,975,948	
On 94,917 double centners of crushed sugar at 10 marks	949,170	
		65,900,745
		12,699,570
Managing expenses at 4 per cent		3,144,011
Net receipts from the material tax		9,555,557
Net receipts from the consumption tax		50,814,291
Total income		60,369,848

The present bounty or profit accruing to the manufacturers is conceded to be about 2.12 marks per 100 kilograms. During the last year it is estimated that the Government suffered a net loss of 16,000,000 marks.

PROJECTED CORRECTIVE LEGISLATION.

To correct permanently this condition of affairs the Reichstag has now under consideration a measure which proposes to abolish altogether the old material tax, or weight duty, and with it the system of rebates. The consumption tax is increased to an amount which is considered equivalent to the present weight and consumption duty. Though the rebate is withdrawn, all sugar intended for export is exempt. During the year 1889–'90 about 4,400,000 double centners of sugar entered into the home consumption. This is considered as a normal yearly consumption in the German sugar-taxing districts. Without regard to the natural increase of the population or the increase of consumption per head, it is believed that an average yearly consumption of 4,500,000 double centners can be reckoned upon in the near future. This amount of sugar, taxed at 22 marks per double centner, would give an annual return of about 99,000,000 marks, which, after deducting the necessary collecting expenses, would leave to the imperial treasury a clear total of about 95,000,000 marks, as against about 60,000,000 marks under the present arrangement. Such a showing, it is argued, could not be brought about by adhering to the present system.

ARGUMENT FOR AND AGAINST THE NEW METHOD OF TAXATION.

In support of this innovation it is urged that the expenses of the Empire have increased to a very great degree during the past few years, and that it can be predicted with certainty that they will continue to increase. This is due, first of all and chiefly, to the enormous military outlay for the improvement of the national defenses. As secondary causes, the new pension insurance law and the increases granted to the various states for their own purposes are mentioned. The present income is inadequate to meet these growing demands, and other and more profitable sources of taxation must be found. The proposed law does not contemplate any added burden, but simply the doing away of the bounty as such.

On the other hand, the combined sugar interest is unanimous in strenuous opposition to the new measure. It is maintained that the present duty is indispensable to a successful competition with foreign producers, notably the French, who are at present receiving decided government encouragement. It is pointed out that the French premium amounts to 7.50 francs for every 100 kilograms, the Austrian to 3.20 marks, and the German only to 2.12 marks. This, in United States currency, would be as $1.45, 75 cents, and 50 cents, respectively. Moreover, the Austrians have the additional advantage of buying at paper and selling at gold value. The complaint is also made that during the last year German sugar was constantly underbid in the London market by French and Belgian sellers.

If this condition of things actually exists, it will deal a severe blow to the German export trade, which is estimated, in round numbers, to

equal three-fifths of the entire production. Of this, England takes at good share. Out of 601,681 tons of sugar, molasses, and sirup exported in 1888, England received 274,277 tons. This is about five and a half times the quantity sent to any other one country.

The United States, according to the German official figures, received a relatively small amount. It is to be said, however, that this amount has been rapidly increasing of late; indeed, the increase during this last year was the most striking feature of our sugar importation. It was nearly three times as much as the year previous and made Germany second only to Cuba as our source of supply. The value of the sugar received by the United States from the most important sugar centers for the fiscal year ending June 30, 1890, was as follows:

Country.	Value.	Per-centage.	Country.	Value.	Per-centage.
Cuba	$39,099,670	38.61	Porto Rico	3,681,247	3.81
Germany	16,098,224	15.90	Dutch East Indies	2,722,320	2.69
Hawaiian Islands	11,559,142	11.42	San Domingo	1,715,460	1.70
British West Indies	8,910,130	8.80	Brazil	1,659,251	1.64
Philippine Islands	6,817,866	6.73	Austria-Hungary	1,578,494	1.56
British Guiana	4,325,370	4.27			

The value of the sugar exported by Germany to the United States in 1887–'88 and in 1888–'89 was $1,321,516 and $5,814,407, respectively.

Aside from the alarm expressed by the exporters for the security of foreign trade, there is the cry of the manufacturers that the abolishing of the material tax will disastrously affect the quality of the beets. Attention is called to the French experience. It is further claimed that the burden of the new law will fall most heavily upon the agricultural and laboring classes. In order to compete at all under the new conditions, the cost of production must be lowered. Therefore the farmer will have to accept a lower scale of prices for his beets and the wage-earner for his wages.

RECENT FRENCH LEGISLATION AND THE M'KINLEY BILL.

It is interesting to note, in connection with this agitation, a recent petition forwarded to Chancellor von Caprivi in the name of the Association for the Beet-Root Sugar Industry of the German Empire. It bears the date of November 7, 1890. After reciting the objections which have already been alluded to in this report, it proceeds to consider two other dangers which have lately arisen. One is the hostile French legislation of July and August of the present year, the other is the McKinley bill. By the former the duty on all foreign sugar is raised and German molasses is shut out altogether from the French markets. As to the recent tariff legislation in the United States, the prediction is made that, under the bounty system and with the aid of improved machinery, Florida and Louisiana will be able to produce nearly 500,000 tons of sugar. Moreover, the fear is expressed that what is known as the reci-

procity clause may work serious harm to the German sugar interests. In the language of the petition, this "falls all the harder upon our manufacturers, because under former laws they had always reckoned upon a good market in the United States. The recent interest taken in the United States in the growing of the beet root is another disquieting feature. The report continues:

It is not doubted that a country with such enormous plains can cultivate beets. Even in Germany, with the light of our present experience, we are not now so particular as regards the soil and climate for beet cultivation.

CONCLUSION.

What effect this opposition will have upon the Reichstag is not yet apparent. The whole course of legislation of late years, though, leaves no doubt that the Government is in earnest in its endeavor to suppress premiums. It is safe to predict that such suppression can not be much longer delayed.

Several tables are here annexed. In Table A it is instructive to note that, while the quantity of beets annually worked up is now triple the amount so employed in 1871–'72, the number of factories has only slightly increased, showing a great increase of capacity, due, in a large measure, to the substitution of the diffusion process. The apparent discrepancy in the amount of income received into the imperial treasury, as shown in Table B and as elsewhere given for the last five years, may be explained by the fact that Table B takes into account the amount of duty received from imported sugar and the rebate afterwards granted.

TABLE A.—*Production and use of beets.*

Year.	Number of factories in operation.	Quantity of beets used.	Raw sugar of all sorts.	Molasses.	Quantity of raw sugar extracted from 100 kilograms of taxed beets.
		Tons.	*Tons.*	*Tons.*	*Kilograms.*
1871–'72	311	2,250,918	186,422	63,892	8.28
1872–'73	324	3,181,551	262,551	91,589	8.25
1873–'74	337	3,528,764	291,041	105,818	8.25
1874–'75	333	2,756,745	256,412	97,603	9.30
1875–'76	332	4,161,284	358,048	133,952	8.60
1876–'77	328	3,550,037	289,423	111,101	8.15
1877–'78	329	4,090,968	378,009	122,813	9.24
1878–'79	324	4,628,748	426,155	133,652	9.21
1879–'80	328	4,805,262	409,415	131,371	8.52
1880–'81	333	6,322,203	555,915	164,984	8.79
1881–'82	343	6,271,948	599,722	150,813	9.56
1882–'83	358	8,747,154	831,995	196,305	9.51
1883–'84	376	8,918,130	940,109	207,978	10.54
1884–'85	408	10,402,688	1,123,030	259,700	10.79
1885–'86	399	7,070,317	808,105	180,178	11.43
1886–'87	401	8,306,671	985,628	215,887	11.87
1887–'88	391	9,963,961	910,698	183,037	13.08
1888–'89	396	7,896,183	944,505	201,189	11.96

TABLE A.—*Production and use of beets*—Continued.

Year.	Beets required to produce 1 kilogram of raw sugar.	Beets raised by factory-owners.	Beets cultivated by factory-owners.	Quantity produced per hectare.
	Kilograms.	*Tons.*	*Hectares.*	100 *kilos.*
1871–'72	12.07	1,504,351	73,690	204
1872–'73	12.12	2,101,301	82,590	254
1873–'74	12.12	2,420,909	88,877	272
1874–'75	10.75	1,908,095	92,655	206
1875–'76	11.62	2,836,307	96,724	293
1876–'77	12.27	2,490,154	98,725	252
1877–'78	10.82	2,872,775	104,783	274
1878–'79	10.86	3,114,030	107,679	289
1879–'80	11.74	2,850,586	113,003	252
1880–'81	11.37	3,871.679	118,431	327
1881–'82	10.46	3,431,754	121,256	283
1882–'83	10.51	4,448,632	129,262	344
1883–'84	9.49	4,205,064	140,843	299
1884–'85	9.26	4,936,246	150,077	329
1885–'86	8.75	4,199,047	138,869	302
1886–'87	8.43	4,436,084	147,782	300
1887–'88	7.65	3,797,652	143,853	264
1888–'89	8.36	4,209,942	149,411	282

TABLE B.—*Taxes and rebates in the German customs territory.*

Year.	Total receipts, including amount from import duty.	Tax rebates.	Net receipts.	Per head of population.
	Marks.	*Marks.*	*Marks.*	*Marks.*
1844–'45 to 1849–'50	20,457,800	2,578,400	17,879,400	0.61
1850–'51 to 1855	21,119,600	2,212,900	18,906,700	0.57
1856 to 1860	27,374,300	1,368,900	26,005,400	0.78
1861 to 1865	32,708,800	864,200	31,844,600	0.90
1866 to 1870	39,537,400	4,198,500	35,338,900	0.94
1871–'72 to 1875–'76	58,872,500	4,159,000	54,713,500	1.32
1876–'77	60,154,500	11,618,200	48,536,300	1.13
1877–'78	67,824,600	18,009,100	49,815,500	1.15
1878–'79	76.171,800	25,627,100	50,544,700	1.15
1879–'80	78,605,000	24,399,500	54,205,500	1.22
1880–'81	102,645,000	56,496,500	46,148,500	1.12
1881–'82	101,869,200	44,992,200	56,877,000	1.26
1882–'83	141,684,600	74,397,700	67,286,900	1.49
1883–'84	144,090,600	96,302,300	47,788,300	1.05
1884–'85	167,821,600	128,452,700	39,368,900	0.86
1885–'86	114,559,800	90,067,600	24,492,200	0.53
1886–'87	142,445,200	108,821,000	33,624,200	0.72
1887–'88	120,245,300	105,568,000	14,677,300	0.31
1888–'89	110,171,100	80,076,100	30,095,000	0.62

ALBERT H. WASHBURN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Madgeburg, December 27, 1890.

THE SUGAR INDUSTRY.

TRANSLATED AND FORWARDED BY CONSUL-GENERAL EDWARDS, OF BERLIN.

National economists have heretofore never attempted to follow a world industry so far as possible through all lands in which it has obtained a footing, everywhere inquiring how it originated, how, under the influence of the requirements of natural production, it has developed, how it has been helped or hindered by legislative measures, how the social and political conditions of the country have influenced its extension, etc. In times like the present, in which trade and industry expand more and more beyond political frontiers, it becomes day by day more difficult to keep in view the home industry competing in the world's market. Hence it appears how easily false conclusions and erroneous conceptions concerning the condition of a great industry may arise and how governmental and legislative measures may exercise disastrous influences.

For this reason the attempt of Dr. Hermann Paasche, professor of political economy at the University of Marburg, to place side by side historical sketches of the development of the sugar industry in all countries of the world is of practical value.

The sugar industry is certainly worthy and deserving of such treatment at the hands of national economists.

It is a world industry in the true sense of the term; it is affected by a very great variety of influences; its powers of vitality and growth often depend upon the system of taxation which obtains, and, in the central European states, it exerts an intense influence upon agriculture.

As Professor Paasche says in the preface to his book (Sugar Industry and Sugar Trade of the World, published by Gustav Fischer, in Jena), in recent years the development of the sugar industry has become of special interest in theory and practice.

By temporary overproduction, by the accidents of trade, and, above all, on account of a series of legislative measures in the chief producing districts of the continent, a few years ago the sugar-fabrication industry was brought almost to the brink of ruin.

Suddenly and unexpectedly a crisis of such threatening character overtook this industry that even the most hopeful optimists wavered and complaints were heard from all beet-sugar-producing countries as well as from the tropical colonies. Never has the fight for existence between beet and cane sugar been so fierce and energetic as within the past few years, and the governments of France, Russia, Austria-Hungary, etc., as well as those of the colonial states, have exerted themselves to support and strengthen their industries in this battle for existence by means of internal-tax and customs-tariff expedients of many sorts. Unfortunately all these measures have exerted a bad influence upon the state of affairs by protracting and directly imbittering the crisis. The years of the most recent development of the sugar industry, therefore, as well as of the agitation for reform in the matter of sugar taxation and customs legislation, are of great interest to the economist and financier. They give a clear insight into a great world industry, in the continual struggle of competition, developing itself further under the pressure of "hard times;" an insight into the deep influence exerted upon it by State legislation, and they show how little foundation plausible theories have in such changeable conditions.

In a most conscientious way Professor Paasche proceeds to investigate the development of the sugar industry in its many homes. In this examination the German industry is entitled to the first place, because both in technical and agricultural development and in the amounts produced it stands first.

In 50 years the German sugar industry has made such forward strides that instead of 17 only 7.99 metre-centners of beets now produce 1 metre-centner of sugar, and that the 2.077 metre-centners of beets, which in the campaign of 1836–'37 were used during the entire season, on the average, by one factory, in many factories now would not suffice for a single day's work. The entire beet-sugar production of Europe in 1889–'90 was 3,520,000 tons, of which Germany supplied 1,260,000 tons, or more than one-third. The growth to this degree of productiveness is very carefully followed by Professor Paasche, in a manner indicative of his mastery of the subject and of the statistical, legislative, and political-economical material pertaining thereto.

The work contains much practical and valuable material and is particularly useful as giving detailed facts in regard to the sugar districts which compete with the German beet-sugar industry, and also in regard to cane-sugar-producing regions. The author has done the beet-sugar industry an especially valuable service by presenting in convenient form facts formerly very difficult of access in regard to the existence and development conditions of the cane-sugar industry.

The value of this work is doubled for the German beet-sugar industry by its appearance exactly at this time, when legislative reform of the sugar-tax system is being discussed in official circles.

PROGRESS OF THE SUGAR-BEET INDUSTRY.

REPORT BY COMMERCIAL AGENT WASHBURN, OF MAGDEBURG.

THE GERMAN INDUSTRY.

Introduction.—Recently published statistics touching the sugar-beet industry in Germany show no abatement in the steady progress which is one of its distinguishing features. The much-discussed law abolishing the bounty system, to which I had the honor to call attention in an earlier report, lately passed the Reichstag after a long debate. Very naturally this threatened change called forth some months ago a storm of vigorous protests, and incidentally it was made the text for a seemingly serious and despondent disquisition upon the future of the German sugar-beet industry. The fact that several other countries, notably France and Austria, are already enjoying larger bounties, the rapidly spreading cultivation of the beet in all temperate belts, and our new tariff bill were among the enumerated causes of the decadence in Germany. It is possible that the authors of these articles were sin-

cere in their visions of impending ruin, but the simple truth is that the German, through years of accurate and scientific experiments, leads the world in the cultivation of the beet and the manufacture of it into sugar. That best of teachers—experience—has taught him every phase of the question presented to him for economic solution. While therefore he may have his regrets at the inevitable doing away of a system, which, it can not be gainsaid, has been a prime factor in the present advanced development of the beet industry, he yet has not the slightest intention of yielding up his hard-earned vantage to anybody else. He understands perfectly well his strength, and, understanding, will use it to keep right where he is—certainly for some years to come.

New legislation.—The new law was passed May 9 by a vote of 159 to 126. In view of the very determined opposition to any change in the form of taxation, a modification of the original draft of the new measure was to have been expected, and this is what happened. It is to be borne in mind that there are two methods of taxation prevailing in Germany—the material or weight tax on the beet roots, and the consumption tax levied on the sugar itself when it enters into home consumption. Since 1861 a drawback has been granted on the material tax when the sugar was exported, and this has operated as a concealed bounty. Under the new law, after August 1, 1892, the material tax is to be abolished altogether and a consumption tax substituted of 18 marks* per metric hundredweight.† As an offset to the doing away of the old method, an open export bounty is to be granted for 5 years. For the first 3 years the scale will be 1.25 marks per metric hundredweight of raw sugar, and 2 marks and 1.65 marks for refined sugar; for the last 2 years the bounty given will be 1 mark, 1.75 marks and 1.40 marks respectively. At present the concealed bounty is supposed to be about 2.25 marks per metric hundredweight of raw sugar.

Outlook.—Some time before the present season opened, information from the most trustworthy sources pointed to an increase in the acreage this year of 5 per cent. Later developments have confirmed this estimate. This growth is likely to be maintained and is the natural outcome of the moderately satisfactory price of sugar of late, the fine yield of the beet root during the past 2 years, and the erection of new factories. It is quite true that the legislation just passed comes too late to affect the present campaign, but it is equally true that no steps would have been taken looking to a permanent enlargement of the industry if there had been any question as to the disastrous effects of a law whose passage has been long foreseen.

Over and beyond the first estimated increase for this year, there will be a further extension in the acreage given to the beet root, due to a cause accidental and temporary. This has been the state of the weather. During March and April frequent frosts and falls of snow and heavy

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* One mark = 23.8 cents. † One metric hundredweight = 220.5 pounds.

rains and inundations in the Rhine district made sowing impossible. Labor was confined to the preliminary and rougher work—manuring and plowing. The drilling of the beet kernels consequently took place later than usual. What was more serious, though, in many places the moisture of the ground prevented the sowing of the wheat crop until the season was too far advanced. The result was that a very considerable number of intended wheat fields were at the last moment turned into beet fields. Of course, the final yield may bear no proportion to the area cultivated. Much must always depend upon the quality of seeds selected and the care taken in cultivation, but after this the success or failure of a season's crop is merely a question of favorable or unfavorable weather.

Some newly tabulated statistics are here given:

Cultivation and yield.

Year.	Beet area.	Average yield per hectare.	Year.	Beet area.	Average yield per hectare.
	Hectares.	*Met. cwt.*		*Hectares.*	*Met. cwt.*
1889–'90	298, 560	329	1884–'85	316, 191	329
1888–'89	280, 361	282	1883–'84	298, 271	299
1887–'88	263, 786	264	1882–'83	254, 278	344
1886–'87	276, 889	300	1881–'82	221, 624	283
1885–'86	234, 116	302	1880–'81	193, 339	327

1 hectare=2.471 acres.

In Germany very many beets are grown by the manufacturers themselves. The purchased roots moreover are generally grown by contract and under special instructions furnished by the manufacturers. The proportion during the past ten years has been:

Year.	Grown by manufacturers.	Purchased.	Year.	Grown by manufacturers.	Purchased.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
1889–'90	51.8	48.2	1884–'85	47.5	52.5
1888–'89	53.3	46.7	1883–'84	47.2	52.8
1887–'88	54.5	45.5	1882–'83	50.9	49.1
1886–'87	53.4	46.6	1881–'82	54.7	45.3
1885–'86	59.4	40.6	1880–'81	61.2	38.8

Year.	Active factories.	Beets worked up.	Beets required for 1 met. cwt. of raw sugar, not including sugar extracted from molasses.
		Met. cwt.	*Met. cwt.*
1889–'90	401	98, 226, 352	8.09
1888–'89	396	78, 961, 830	8.36
1887–'88	391	69, 639, 606	7.62
1886–'87	401	83, 066, 712	8.49
1885–'86	399	70, 703, 168	8.75
1884–'85	408	104, 026, 883	9.26
1883–'84	376	89, 181, 303	9.49
1882–'83	358	87, 471, 537	10.51
1881–'82	343	62, 719, 479	10.46
1880–'81	333	64, 222, 030	11.37

Cultivation and yield—Continued.

Year.	Raw sugar obtained per hectare.	Working days.	Production, raw and refined, reckoning from September to August.
	Met. cwt.		*Tons.*
1889–'90	42.31	95.3	1,264,607
1888–'89	35.29	84.3	990,604
1887–'88	36.41	76.6	958,353
1886–'87	36.54	90.5	1,012,968
1885–'86	35.82	82.3	838,131
1884–'85	36.52	119.3	1,154,816
1883–'84	31.51	119.4	986,403
1882–'83	32.73	132.4	848,124
1881–'82	27.05	111.2	644,780
1880–'81	28.76	123.9	594,223

GENERAL EUROPEAN OUTLOOK.

The same generally satisfactory and prosperous condition of the beet industry is noticeable throughout Europe. Reports show that in many countries early sowing was prevented, as in Germany, by unfavorable weather. The most reliable estimates indicate that there will be an increase of acreage in France of from 12 to 15 per cent., probably the latter figure; in Austria, of from 8 to 10 per cent.; in Belgium, of 15 per cent. In Holland and Russia the reports are conflicting and not very encouraging. The increase throughout Europe is likely to be about 7 per cent.

The sugar production of Europe, including the cane sugar of Madeira and Spain, during the past 10 years has been as follows:

	Tons.		Tons.
1889–'90	3,627,967	1884–'85	2,672,883
1888–'89	2,783,844	1883–'84	2,430,813
1887–'88	2,481,950	1882–'83	2,157,034
1886–'87	2,750,206	1881–'82	1,915,974
1885–'86	2,239,973	1880–'81	1,814,545

Statement showing the beet-sugar production by countries, including estimate for the current year.

Country.	1890–'91.	1889–'90.	1888–'89.	1887–'88.	1886–'87.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Germany	1,335,000	1,264,607	990,604	959,156	1,012,968
Austria	760,000	753,078	523,242	428,616	523,059
France	700,000	787,989	466,767	392,824	485,739
Russia	530,000	456,711	526,387	441,342	487,460
Belgium	200,000	221,480	145,804	140,742	135,755
Holland	65,000	35,813	46,040	39,280	36,098
Other countries	80,000	80,000	87,000	79,980	69,127
Total	3,670,000	3,619,678	2,785,844	2,481,950	2,750,206

The total sugar production, beet and cane, for the same period is set down at:

	1890–'91.	1889–'90.	1888–'89.	1887–'88.	1886–'87.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Beet sugar	3,670,000	3,619,678	2,785,844	2,481,950	2,750,206
Cane sugar	2,385,000	2,049,464	2,318,708	2,501,735	2,371,221
Total	6,055,000	5,669,142	5,104,552	4,983,685	5,121,427

ALBERT H. WASHBURN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Magdeburg, June 9, 1891.

RUSSIA.

RUSSIA—1872.

REPORT BY CONSUL SMITH, OF ODESSA.

The great industry of South Russia is agriculture, which, the past year, has been very successful, as shown by the exportations from Odessa and other ports.

The beet-sugar industry, protected by high tariffs, has grown very much these last years, the product having become ample for the wants of the people, and prices reduced to eight, ten, and twelve kopecks the pound, according to quality. This is nearly as low as sugar could be imported if duty free.

Last fall the Government, satisfied that great profits were derived by the manufacturers, determined to lay a heavy excise on it for revenue. At about the same time, however, it turned out that the beet crop was deceptive or deficient, so that the product was considerably diminished and prices accordingly mounted up, so that foreign sugar could be imported and sold in competition, notwithstanding the high tariff.

It is now feared by some that the sugar industry may be discouraged, if not destroyed. The general prosperity and progress of the country continue.

T. C. SMITH,
Consul.

UNITED STATES CONSULATE,
Odessa, May 4, 1872.

RUSSIA—1875.

REPORT BY CONSUL RAWICZ, OF WARSAW.

The cultivation of beet root for the manufacture of sugar has of late years received an immense development in Poland and the adjoining provinces of Bothnia, and particularly that of Podolia.

As early as 1812 the Government endeavored to introduce this manufacture into Poland, by offering loans and promising freedom from conscription to persons employed in it. These means did not, however, meet with success, the first factory having been established only in 1831, and the first refinery in 1839. Since that time this manufacture has received a great development, as there are at present, according to the last official returns, 38 factories, employing 11,389 workmen, the value of produce being estimated at 9,379,669 rubles. The average prices of sugar in 1873 were: Refined, 4 rubles 65 kopecks; farina, 3 rubles 30 kopecks, per stone of 24 pounds. The conversion of beet root into sugar is entirely performed from the end of September to the commencement of April in each year, beyond which time the beet root, if kept, becomes deteriorated.

JOSEPH RAWICZ,
Consul.

UNITED STATES CONSULATE,
Warsaw, October 1, 1875.

RUSSIA—1877.

REPORT BY CONSUL DYER, OF ODESSA.

Industries of every nature are in a languishing condition. Some of the largest establishments at Odessa have during the year gone into liquidation and many others are upon the verge of bankruptcy.

The industry in which the largest amount of capital is engaged is in the manufacture of sugar from the beet root. At the end of 1875 there had been a crisis in this business, and the early months of 1876 brought failures of such establishments in all directions. The withdrawal of the duty on exported sugar gave for a time some relief, but toward the end of the year failures seemed almost epidemic from the Baltic to the Black Sea. At the recent convention of persons interested in this business at Kief, it was discovered that but two of all the companies represented had been able to pay a dividend. With most of them it was simply a question of being able to continue their operations. The production of the root is said to very rapidly exhaust the soil, while the destruction of the forests for purposes of fuel for steam is an item that might well be considered, in view of the scarcity of timber in all South Russia.

L. E. DYER, *Consul.*

UNITED STATES CONSULATE,
Odessa, October, 1877.

RUSSIA—1881.

REPORT BY CONSUL-GENERAL STANTON, OF ST. PETERSBURG.

Governments.	No.	Quantity.	Value.	Laborers.	Insured value.	Excise.
		Tons.				
Kief	65	84,384	$10,990,865	24,011	$12,322,500	$575,156
Podolien	50	44,347	4,978,585	15,946	8,403,100	383,654
Charkoff	21	*23,195	*2,577,750	8,243	2,658,750	182,380
Tshernigoff	14	4,629	585,440	5,187	1,062,100	73,499
Kursk	12	*13,695	*1,525,315	4,925	1,672,500	110,015
Volhynien	11	12,254	1,525,315	5,175	2,786,300	90,673
Voronesh	7	2,455	338,245	1,969	482,500	29,287
Tamboff	5	2,962	425,925	1,475		34,695
Tula	3	3,018	480,700	1,440		39,300
Poltava	2	801	97,150	538		8,924
Pensa	2	440	95,246	375	1,429,000	4,431
Bessarabia	1	504	60,200	580		4,728
Orel	1	203	27,120	170		4,375
Mohileff	1	145	28,236	190		2,168
Minsk	1	*43	*4,780	88		345
Total Russia	196	193,075	23,740,872	70,312	30,816,750	1,543,630
Warsaw	19	*14,551	*2,182,500	*[1]1,708	1,900,000	183,268
Kalish	5	*2,206	*275,753	*[2]388	500,000	27,870
Lyublin	4	1,994	285,700	1,595	615,950	24,054
Radom	3	1,277	184,596	617		17,544
Kyeltzl	2	1,186	155,184	*[3]384		17,748
Peterkoff	2	*1,114	*139,394	131	1,418,050	15,535
Lomsha	2	652	85,135	250		5,950
Plotsk	2	1,258	139,750	550		15,834
Syedletz	1	*462	*51,340	*[4]84		5,817
Total Poland	40	24,700	3,499,352	*[5]5,707	4,434,000	313,620
Grand total	236	217,775	27,240,224	*[6]76,019	35,250,750	1,857,250

* Calculated on the estimated capacity of works.

[1]Actually in 1879–'80, 9,683. [2]Actually in 1879–'80, 1,552. [3]Actually in 1879–'80, 685. [4]Actually in 1879–'80, 380. [5]Actually in 1880–'81, 22,879. [6]Actually in 1880–'81, 93,190.

From the foregoing table it will be seen that during the season of 1880–'81 there were in operation in all Russia 236 sugar works, 196 being in Russian and 40 in Polish governments.

It has hitherto been the practice of the Russian Imperial Government to estimate, from existing data, the capacity of a sugar mill and to collect the excise duty on the estimated—without regard to the actual—production.

According to this established rule there were 83,846 tons (4,658,146 poods) of sugar produced, viz, 69,824 tons (3,879,129 poods) in the Russian and 14,022 tons (779,026 poods) in the Polish governments. The excise duty collected amounted to $1,857,250.

In consequence of the introduction of more perfect apparatus the actual exceeds by far the estimated production.

Thus in the Russian the relation of the established standard to the actual production was as 1 to 2.7664 and in the Polish government as 1 to 17.653, so that the actual production of sugar was 217,861 tons (12,103,415 poods), the Russian Government producing 193,163 tons (10,731,295 poods) and the Polish 24,698 tons (1,372,120 poods).

The value of the production was $27,236,690, viz, $23,737,286 for the Russian and $3,499,208 for the Polish works.

This great difference between the estimated and the actual produc-

tion has called forth a decree whereby the excise duty is henceforth to be collected on the actual production, at first at a less, later at an increased rate. It is believed that this change of system, which has already increased the price of sugar, will treble the government's receipts.

The buildings and machinery of Russia's beet-root-sugar manufactories are insured for $35,250,750 (of which $30,816,750 are on Russian and $4,434,000 on Polish mills), which is an evidence of the magnitude of this branch of industry.

There were 93,190 laborers of both sexes employed, viz, 70,312 in the Russian and 22,879 in the Polish works.

Many mills are largely engaged in cultivating the beet root, whilst others depend entirely on others for their raw material.

In the Russian Governments the manufacturers cultivated themselves 240,967 acres of beet root, which yielded 1,327,697 tons—7,376,098 berkovets—being an average yield per acre of 5.5 tons. Besides their own production the manufacturers purchased 1,105,947 tons for $3,763,892, the average price per ton being $3.43.

Assuming that the other producers obtained an equal average yield with the factories they would have cultivated 201,560 acres, with a return per acre of $18.86, to which should be added the value of the leaves and pressed roots returned by most of the factories.

From this will be seen how great is the agricultural importance of the beet-root-sugar trade in Russia, to which, in fact, many of the provinces owe their prosperity exclusively. Altogether there were 442,527 acres devoted to the culture of the beet root. About 34⅓ per cent. of the mills are the property of stock companies.

EDGAR STANTON,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
St. Petersburg, February 2, 1882.

RUSSIA—1883-'84.

REPORT BY ACTING CONSUL-GENERAL SWANN, OF ST. PETERSBURG.

This industry is mostly confined to limited areas in the southwestern, Little Russian, and Prevestland provinces of the Empire, and from the total number of sugar works in successful operation during the year 1883 the distribution was as follows:

In the southwestern provinces there were 128 establishments in operation, of which the greater number (68) were in the government of Kieff, and 49 in Podolsk; in Little Russia 38; in the government of Kharkoff 22, and in the Prevestland provinces 42. In nine other governments 38 establishments were in active operation, of which latter number 14 were in the government of Koursk.

The beet-root plantations under cultivation in 1883—and in connection with this sugar industry—equaled 735,000 acres, being an excess of 102,051 acres over the area under cultivation in 1882. Of this total 302,942 acres belonged to the sugar companies, and 432,058 acres to planters.

During the year 1883 the sugar works consumed 22,473,096 berkovets of beets (1 berkovet Russian equals 360 English pounds), of which quantity 22,172,777 berkovets were accounted for as follows:

Sugar works located in—	1883.	1882.
	Berkovets.	*Berkovets.*
Southwest governments	12, 511, 451	*663, 716
Prevestland provinces	3, 516, 996	*972, 365
Other governments	6, 484, 649	†888, 651

* Decrease. † Increase.

Results obtained from these operations were as follows, given in poods (1 pood equals 36 pounds English):

	Poods.
Best sugars	1, 553, 295
White and moist	14, 422, 554
Yellow moist	9, 306
Refined molasses	1, 249

Being an excess of 894,104 poods over the workings of the former year 1882, although in the manufacture of best sugar there was a decrease in the output of 528,916 poods as compared with 1882.

From the total quantities of best refined sugars and lower grades, the manufacture has been distributed as follows for 1883:

REFINED BEST.	Poods.	LOWER GRADES.	Poods.
Warsaw	717, 426	Kieff	4, 991, 283
Keiff	264, 176	Podolsk	2, 924, 499
Podolsk	252, 179	Kharkoff	2, 230, 281

The total number of employés engaged in the sugar industry at the manufactories, exclusive of beet-root cultivation, was, in 1883, 94,580 persons; of which number 73,334 were male laborers, 13,869 were female laborers, and 7,377 were children.

Notwithstanding low prices in connection with this industry, the trade returns during the past year 1884 have been satisfactory, the exports being as follows:

Refined sugars.	1884.	1883.
	Poods.	*Poods.*
Baltic Sea exports	4, 830	.....
Black and Azoff Sea exports	28, 990	8, 091
Land transit	39	22
	33, 859	8, 113

The profits derived by the companies engaged in this industry are not so great for the year 1884 as in 1883, and in the greater number of instances the profits and bonuses at the disposal of the shareholders in the sugar undertakings of Russia were much diminished, as will be seen from the following details collected from the Kierlanui, a journal devoted to this industry.

The dividends of the sugar refinery Lorodok for the year 1884 was 20 per cent. as compared with 25 per cent. gain in 1883. The refinery Iaropowitch gave 15 per cent. The Kieff Sugar Refining Company declared a dividend of 8 per cent. as compared with 10 per cent. in 1883. The Kalinsky Sugar Works gave a dividend of 20 per cent. as compared with profits exceeding 40 per cent in 1883, and the Romanoffsky Refinery gave 15 per cent. for the late year's working.

Other sugar works and refineries gave results not less satisfactory to their shareholders, though, as already intimated, the dividends were not so great as in 1883.

JAMES V. R. SWANN,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
St. Petersburg, May 12, 1885.

RUSSIA--1886.

REPORT BY CONSUL HEENAN, OF ODESSA.

BOUNTIES.

I submit the few statements this dispatch contains on the subject of sugar in Russia with the intention of calling the attention of the Department in the first place to the enormous quantity produced, and the consequent effect on the price of the article, and in the second place to the action of the Russian Government in coming to the relief of the sugar manufacturers, and the effect of the same on the sugar interests generally.

Russia did not export sugar until last year, except in very small quantities, and then only to neighboring countries, the home consumption heretofore absorbing all that could be raised, the quantity required being between 720,000,000 and 792,000,000 pounds each year.

The producers, who are also the manufacturers of sugar, for years past have been realizing enormous profits from the protection afforded them by the Government in placing a high tariff on all foreign sugar. These profits, according to good authority, have reached as high a figure as 50 per cent., besides increasing the value of the lands from 150 to 200 per cent., owing to the cultivation of the beet.

In consequence of these high profits there was an overproduction of sugar. This was foreseen early in 1835, a surplus of between 288,000,000 and 360,000,000 pounds being the result. This surplus caused prices to

drop to the low price of 5 cents per pound. The wealthy owners at once appealed to the Government for aid to keep up, not their industries, because it was shown that even at this low figure a moderate profit would result, but to keep up their large profits.

The Government yielded to this demand, and gave a premium or bounty of 1 ruble per pood, or 50 cents on every 36 pounds of sugar exported, until 72,000,000 pounds should be reached. As this quantity was not sufficient to relieve the market of its surplus, free permit was given for sugar exported, with a premium or bounty of 40 cents on every 36 pounds exported until May 1, 1886 (Russian calendar).

The quantity exported thus far (April 8) is about 216,000,000 pounds, so that from 72,000,000 to 144,000,000 pounds remain to be disposed of.

The greater part of the sugar exported was sent to England. It was not sold, but was consigned, and still remains unsold on the English market, which is depressed by the supply pouring in from all countries.

The bounty allowed by the Russian Government was not sufficient to induce the owners of the surplus sugar here to part with their stock. They have therefore applied to the Government for an increase of this bounty, with the additional request that the bounty be paid in the future on all sugar exported, and that the manufacturers be not asked to return the bounty already paid.

The Government levies a tax of 65 kopecks on every pood of manufactured sugar, or 32½ cents on 36 pounds.

The bounty allowed was to be refunded by increased taxation (internal revenue) on future crops.

This additional demand on the part of the sugar interest was received with great discontent and opposition by the agricultural classes generally, and the question was asked, "Why should not the Government give a bounty to other products which were exported, wheat, for instance, as well as sugar, which had a long run of prosperity?" The other interests of the country objected to paying tribute to increase the profits of the wealthy sugar manufacturers.

The Russian minister of finance refused to grant the request made, and declined to help in any other way toward a reduction of this product, declaring that those people who unreasonably increase production must bear the consequences of their own action.

The minister further replied that the difficult situation of the sugar industry produced by the overproduction during the periods of 1884–'85–'86 has attracted the attention of the Government. By two resolutions of the committee of ministers there was given to the manufacturers of the whole Empire an export premium of, first, 1 ruble, and afterwards 80 kopecks, per pood, and through this measure undoubtedly a collapse of prices was prevented.

However, on the part of the manufacturers, different petitions and appeals have been made, and are still being presented, regarding which the minister of finance sees himself induced to give some explanation.

Some of the applications demand partly an increase and partly a non-refundable premium; others a limitation of production by fixing the amount produced by each manufactory, and extra taxation of the amount exceeded; others again consider all measures superfluous, and expect an amelioration and improvement through the cheapening of production or through the stoppage of work of those factories which are not able to compete.

The minister of finance, therefore, considers it necessary to observe that an increase or a non-refundable export premium is out of the question, and that the premium paid up to now had the purpose to relieve the market of its surplus production for the period of 1885–'86, and must cease in the future, it not being the intention to in any way encourage overproduction.

A continuation of this premium would be purposeless, as the rest of the European States—Germany, France, and Austria—have gone so far in the way of premiums as to make it impossible to compete with them.

The minister of finance intends to protect home production only so far as to supply the home consumption, and not to supply foreign consumers with cheap sugar at the expense of the Russian Government and the Russian people; consequently the minister of finance considers it necessary to inform the sugar interest in advance that the produce of the next season can count upon no premium for export.

Regarding the question of limiting the production, the minister of finance considers it necessary to remark that before all it is the duty of the manufacturers themselves to reduce the production sufficiently for the demand, and that the question is not a matter for Government interference; all consequences of immoderate production must fall on unreasoning producers.

The minister of finance therefore considers it necessary—

1st. To provide for an outlet to some oriental market.

2d. To prevent speculative rise of prices through a lowering of import duties.

3d. To reconsider the arrangement for repayment of premiums.

Regarding the first two points a resolution may be arrived at within a short time, and any further communications on the subject will be useless; but regarding the last point the minister of finance solicits the opinion of parties interested up to May 15, 1886.

The refunding of the premium may be left as heretofore, viz, according to the quantity manufactured, or it may be so allotted as to bring it in proportion to the increased production of certain manufactories.

Petitions only will be received and considered on this latter point; all others which demand favors and assistance, such as abandoning the premium paid on the part of the Government, and also petitions asking for an extension of time on internal-revenue taxes, must not count on favorable consideration.

The grade of this sugar is from 99½ to 100 per cent polarization, all being made from the beet, no cane being used or grown.

The method of refining is not up to the latest improved methods, else the yield per pound of beet would be much larger.

Russia is a high protective-tariff nation, and strongly in favor of and jealously anxious to protect home industries, yet is not willing that the majority of her citizens should suffer in order that a favored few might prosper, a sentiment that will be favorably received in every farming community on this as well as on the other side of the Atlantic.

I venture to hope that the matter contained in this communication may pardon its length.

THOMAS E. HEENAN,
Consul.

UNITED STATES CONSULATE,
Odessa, April 8, 1886.

RUSSIA—1889.

The manufacture of beet-root sugar is yearly increasing in Russia, and the industry is in a flourishing condition. The completion of the Transcaspian Railway opened up an immense field for the sugar interests, and large shipments are constantly being made to Toorkistan, Persia, and the Caspian side of the Caucasus generally. The beet root is largely grown and manufactured into sugar in the governments of Kiev, Podolia, Volhynia, Karkov, Kurtsk, and Veronsk, as well as in some of the more northern districts of Russia.

THOS. E. HEENAN,
Consul.

ODESSA, *March* 26, 1890.

BEET VS. CANE SUGAR PRODUCTION.

REPORT BY CONSUL-GENERAL WILLIAMS, OF HAVANA.

With reference to the inclosed extracts from a few of the dispatches addressed by me to the Department upon the economic state of the island of Cuba since my official connection with this consulate-general in 1875, and as confirmatory of their statements, I now beg to inclose the translation of a paragraph from the Avisada Comercial, of this city, relating to the enormous increase of 800,000 tons in the European beet-sugar crop of this year over that of last year, which sudden increase not only offsets the average annual exportable Cuban crop of some 600,000 tons, but even overshoots it by an excess of 33⅓ per cent.

The general welfare of the inhabitants of this island is so inwrought with their production of sugar, as pointed out by the simile of the labor-

ers A and B in my dispatch No. 724 of August 8, 1878, that I respectfully beg to express the opinion to the Department that the present beet-root sugar crop of Europe, reported at 3,600,000 tons, ought to be a subject of preferred solicitude and consideration on the part of the Government of Spain.

RAMON O. WILLIAMS,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Havana, April 9, 1890.

BEET-ROOT SUGAR.

[Inclosure 1 in Consul-General Williams's report.—Translation from the Avisada Comercial, Havana April 7, 1890.

The holders of this sweet have been offering it freely during the whole week (in the New York market), but without forcing operations, and it is believed that no sales were made. Owing to the sudden increase in the saccharine richness of the juice from the root in Germany, Mr. Licht (the statistician) has had to raise his estimates of the production of that Empire to 50,000 tons more; and as the total crop of Europe now reaches 3,600,000 tons, there results an increase of 800,000 tons in the present crop of 1889–'90 over that of 1888.

It is therefore not strange that in sight of such a formidable increase of supply the American refiners feel they will be able to cover their needs of raw sugars at their own pleasure and at moderate prices, and therefore show no anxiety to accept present offerings.

BEET-ROOT SUGAR IN 1889–'90.

[Inclosure 2 in Consul-General Williams's report.—Translation from the Boletin Comercial.]

Mr. Licht estimates, in his last bulletin, the beet-root sugar crop for 1889–'90 at the following figures:

Countries.	Tons.	Countries.	Tons.
Germany	1,250,000	Holland	60,000
Austria-Hungary	730,000	Other countries	80,000
France	750,000	Germany, increase, as explained	50,000
Russia	480,000		
Belgium	200,000	Total	3,600,000

NOTE.—In 1888–'89 the total was 2,785,844 tons, and in 1887–'88 it was 2,481,950 tons.

BEET-ROOT SUGAR IN 1875.*

[Inclosure 3 in Consul-General Williams's report.]

The beet-root production during the last year in Europe has reached the enormous amount of 1,100,000 tons of sugar, and the coming crop there, according to the estimates of the best European statisticians, will show another increase of production of

*This and inclosures 4, 5, and 6 are extracts from former reports to the Department by Consul-General Williams.

at least 10 per cent. over that of last year. Should this be realized, then scarcely any market at all will be left in Europe for Cuba and Porto Rico, and, as a consequence, almost their entire crop will be forced for sale into the market of the United States; and, as the amount of supply will determine the price to be paid by the consumer, and not the cost of production, prices must inevitably fall to a lower standard, unless prevented by some unexpected event. In this case some advantages will accrue to the general material interests of the United States as a partial compensation for the injuries inflicted upon our commerce by the action of the differential tariff which reigns here; and, acting like a turbine wheel—receiving the force of impulse at one angle and deflecting it at another—nearly all that reciprocal of trade which should be returned to the United States as the equivalent for the seventy-odd millions of dollars, comprised principally of sugar and molasses sold there by Cuba and Porto Rico, is diverted and imparted by its action to Spain and her dependencies, with its immensity of commercial moving power, for the invigoration and development of their agricultural, industrial, commercial, and maritime interests.

BEET-ROOT SUGAR IN 1878.

[Inclosure 4 in Consul-General Williams's report.]

The following example in domestic economy will illustrate, in some degree, the mode in which these differential duties are, in the wider operation of political economy, eating, cancer-like, into the very vitals of the material prosperity of this island as likewise those of Spain, that of the latter being mostly an effect of the former.

Let it be supposed that the laborers A and B are compelled to go into the labor market to sell their services. They each earn, for instance, $1 per day, and with these earnings they buy the supplies of themselves and families.

The law governing A compels him to buy his bread from a certain baker, and in the same way his meat, groceries, shoes, and clothes from a designated butcher, grocer, shoemaker, and tailor, to each of whom he has to pay, say, 30 per cent. higher for his supplies than the laborer B, because the latter has the right to buy wherever he can get his supplies cheapest. Now, it is clear in this case that, though both laborers earn the same wages, this differential taxation reduces the exchangeable value of a day's labor of A to 70 cents when compared with the day's labor of B, which is worth to him $1 in the purchase of supplies.

Further, and what probably is a still more important effect for the purposes of this analysis, is that B possesses a competitive advantage of 30 per cent. in the labor market over the laborer A.

Now, the same simile holding good when treating of the selling and buying power of a nation, it follows that the exports of Cuba bear the same relation to its economic being as the wages of the laborer A bear to his personal welfare and to that of his family.

Cuba has, from the necessity of self-preservation, to send her exports, consisting mostly of sugars, molasses, tobacco, and cigars, to whatever market will pay her best. She finds the best market for her products in the United States, where she sends about 90 per cent. of her exports.

Now, with her exports out, she buys her imports in, in a similar manner as laborer A with his daily earnings buys his supplies.

But the law governing Cuba subjects her imports to the action of a differential tariff, so constructed as to force her to buy to the furthest possible extent from a certain nation and to employ for the purposes of transportation a designated shipping.

Accordingly, Cuba is pressed to purchase her flour, provisions, groceries, shoes, dry goods, and all other articles of consumption in Spain, and to bring them in Spanish shipping, only buying from other countries when these, despite the discrimination, are able to sell to her cheaper than Spain.

Thus Cuba, like laborer A, suffers a great loss in the exchangeable value of her exports, although getting the same prices for them when compared to the exports of other sugar-producing countries, but who, like laborer B, have the right to buy wherever they can get the cheapest.

In this arrangement we probably find the most glaring example of economic fallacy existing in any country doing an extensive foreign commerce; for, just in proportion as Spain is "protected" at the expense of Cuba, it being an unreciprocal protection, the exchangeable value of Cuba's exports is thereby lessened, as in the case of the services of laborer A, she suffering a corresponding diminishment in the amount of imports purchasable by her exports, just upon the same principle that a given measure shortened at one end is thereby shortened at both ends.

Further, to the extent of the harm done by the operation of these differential duties, so does the competitive power of the beet-root sugar of Europe and the cane sugar of all other countries operate against Cuba in the sugar-consuming markets of the world; and to such a potent degree has this competition risen, through the increase of sugar-production, which, at the same time, is gradually affording the United States, through other channels, that reciprocity of trade diverted from them by the differential tariff of Cuba, that Cuba's sugars are now quite forced out of the markets of Europe, and she is helplessly reduced to the sugar market of the United States, notwithstanding the high import duties there on sugar, to which Cuban planters and high Spanish officials point, believing that they come out of the Cuban producer instead of the American consumer. But, were such the fact, it is surprising that Cuba does not attempt to avoid their payment by the shipment of its sugars to Great Britain, where, at present, no import duties are levied on the article.

It is easy to perceive that the more necessity compels Cuba to gravitate to the United States for a market to sell in and the more Spanish legislation compels her, on the other hand, to go to Spain as a market to buy in, so will her commercial status become abnormal, and in like proportion must the effects in time be disastrous to Cuba and to Spain; for it is impossible for a people to stand when so divided that its commercial necessities are in one direction and its political ties in another directly opposite.

BEET-ROOT SUGAR IN 1878.

[Inclosure 5 in Consul-General Williams's report.]

At a time not far remote, when Cuba, owing to the temporary effects of factitious and accidental causes, made nearly 40 per cent. of the sugar supply of the world, and when her market lay principally in Great Britain and other countries of Europe, where, from motives of interest, no retaliatory duties were imposed on merchandise imported and exported in Spanish shipping, it was, from this relatively dominating position, temporarily feasible for Spain to maintain in Cuba a differential tariff; but, now that her quota of that supply scarcely reaches 18 per cent., and Cuba's market to sell in having changed from Europe to be confined almost exclusively to the United States, where these differential duties are offset by retaliatory duties, it has ceased to be longer beneficially practicable.

For some time past the operation of this differential tariff has been reactive and destructive of the interest and welfare of Cuba, and it now only operates as a "protection" favoring the development of the sugar industry in all other countries just to an extent exactly correlative to the amount of exchangeable value it detracts from Cuba's export in their purchase of her exports.

The Spanish Government is now in the dilemma of either continuing this differential tariff or of abolishing it. If it chooses the first alternative, it will thereby, in a brief series of years, destroy not only the sugar industry of the island, but with it, as secondary effects, all the many interests that derive their moving power from that crop,

such as the railroads, the coastwise shipping, exporting merchants, banks, sugar warehouses, cooperage establishments, wharves, lighters, and depriving of employment its brokers, clerks, mechanics, laborers, stevedores, and rendering, also, valueless to creditors its public debt. The export basis of the island once dissipated, its import business, too, ceases, and then another train of large and small business establishments will simultaneously go out of existence for the want of sugar, out of which staple flows their moving power. Coincidently with the working out of this process, other countries are striving to occupy the position of Cuba as sugar-purveyors to the United States. If, however, Spain would act from a higher standard of thought and with the wisdom and sense of responsibility that ought to be the rule of all governing powers, and abolish this tariff, thereby leaving Cuba with the right to buy wherever she can do so the cheapest, then in that event the great bulk of Cuba's imports must come from the United States, for the simple reason that she can there buy them cheapest, reaping, besides, a great saving of time, because of the proximity of the United States, over bringing them from Spain and other European countries.

As a proof of the capability of the United States to furnish the imports of Cuba to the advantage of its population, we have the practical fact that the dry goods merchants of this city are at the present day importing American calicoes from the United States via Liverpool, England, whence they are brought in Spanish steamships to Havana, with the surcharge of commission, freight, truckage, and marine insurance consequent upon the roundabout way of importing enforced by this differential tariff, instead of bringing them direct from New York or Boston. And this only means that Cuba gets just so much less of imports in exchange for her exports and that other sugar-producing countries are literally "protected" by Spanish legislation just to that extent at the expense of Cuba.

BEET-ROOT SUGAR IN 1886.

[Inclosure 6 in Consul-General Williams' report.]

I inclose a copy of F. O. Licht's monthly report of the beet-root sugar industry of Europe, published at Magdeburg, and dated the 20th of November, 1886, as also, for the like purpose of comparison, an accompanying extract of my dispatch No. 291 of the same date of the year 1875, the interval between the two dates being exactly 11 years.

You will please observe that what I called in 1875 in the said dispatch the enormous amount of 1,100,000 tons of beet-root sugar produced in the year 1874–'75 in Europe will, according to the inclosed report of Mr. Licht, reach the coming year to 2,580,000 tons, which is equivalent to an increase of 134.54 per cent. during the last 11 years.

It is likewise observable that, according to the best statistical data of the exports of Cuba attainable in 1875, the percentage of its sugar crop sent in that year for sale to the United States, as reported in my said dispatch, was 81 per cent., whereas the similar data now attainable, and as stated in my report of the 25th of June ultimo (dispatch No. 427), published in the Consular Reports, show that Cuba has shipped to the United States during the present year 94 per cent. of her sugar and molasses crop, leaving a remainder of only 6 per cent. which was shipped to other countries during the same period.

From these facts several very important economic relations are deducible: (1) With the exception of the very limited sugar market of the Spanish Peninsula, Cuba is completely shut out of the European sugar market, Great Britain, France, Germany, Austria-Hungary, Italy, Russia, Belgium, Holland, Denmark, and Sweden and Norway being no longer consumers of Cuban sugar; (2) that, practically, the island is now entirely dependent upon the market of the United States in which to sell its

sugar-cane products. Also, that the existence of the sugar plantations, the railroads used in transporting their products to the shipping ports of the island, the import and export trades of Cuba based thereon, each including hundreds of minor industries, such as the agricultural and mechanical trades, storehouses, wharves and lighters, stevedores, brokers, clerks, bankers, real-estate-owners, shopkeepers of all kinds, and holders of the public debt, are now all directly related to the market of the United States to the extent of 94 per cent. for the employment, and only 6 per cent. to other countries, of the latter mostly Spain, simply for the reason that sugar is the principal economic basis of all those interests.

It is with the knowledge of this fact of the dependence of Cuba upon the United States to the extent of 94 per cent. for a market in which to sell, added to the apprehension that that market may also be taken by other sugar-producing countries from Cuba, that now leads its inhabitants to urge upon the Madrid Government the immediate negotiation of a treaty of commerce to put the island in a more harmonious relationship with its natural market, the United States.

BEET-ROOT AND CANE SUGAR IN NEW ZEALAND.

REPORT BY CONSUL GRIFFIN, OF AUCKLAND.

The large and steady annual increase in the consumption of sugar in New Zealand has directed very general attention to the various methods for its production in this colony. So much interest was taken in the subject that the Government at the last session of Parliament passed an act for the encouragement of the manufacture of sugar from beet root and sorghum. The act provides—

That the colonial treasurer shall, out of the consolidated fund, pay to the person producing the same, one-half penny (1 cent) per pound on the first 1,000 tons of sugar produced from beet root or sorghum grown in this colony, and, further, that no duty by way of excise or ortherwise shall be levied for 15 years from the 1st day of 1885 on any sugar produced in this colony whilst the present import duty of one-half penny per pound continues; but, if the import duty is increased, then an excise may be levied so long as one-half penny per pound at least remains as the difference of duty charged on sugar imported and sugar produced in the colony from beet root or sorghum grown in the colony, to every person producing the same equal to the duty so removed or reduced, but never exceeding one-half penny per pound.

Much opposition was offered to the bill before it became a law. It was urged that it would crush out the industry of the manufacture of sugar from the cane, already established in the colony, and that the bonds system was simply introducing protection in an insidious form, that it would impose a fresh burden on the people, and that it would lead to every other industry demanding similar legislation in its favor. It was also said that it would result in the squandering of public money and in the ruin of speculative manufacturers who might be induced to erect costly factories and machinery. The people throughout the colony, and especially in the district of Auckland, were strongly in favor of the law.

Mr. William A. Graham, of Hamilton, New Zealand, wrote a very able and interesting pamphlet on the inducements offered for the man-

ufacture of beet-root sugar in the Waikato district, which had extensive circulation in the North Island, and Mr. Pond, the government analyst at Auckland, published the results of a series of experiments he had made with beet roots grown in various parts of Auckland, in which the average yield of sugar was 12.29 per cent., the highest being 15 and the lowest 9.82 per cent. The general circulation given to these papers, together with much other matter on the same subject, appeared to settle the question that beet-root sugar could be produced profitably in New Zealand. Excellent results have been obtained from the cultivation of the sugar beet in the Waikato, where the crop is as much a specialty as the orange or banana is in the extreme north. The absence of salt in the soil and in the atmosphere, caused by its inland position, added to its adaptability to the growth of root crops, gives the district very great advantages over the country near the seacoast, and there is now no doubt that the average yield of sugar in the Waikato beet is greater than that produced in Germany and France.

Mr. Pond's paper is so full of interesting and valuable material and contains the results of so many chemical experiments of a direct, practical character that I had thought to reproduce it here entire, although I feel constrained to express the opinion that the production of sugar from the cane will, in the end, prove more profitable than from the beet root:

ON THE SUGAR VALUES OF BEET ROOT GROWN IN THE WAIKATO.

By I. A. Pond, government analyst for the district of Auckland

During the session of 1880 a paper was read before the New Zealand Institute entitled "On the growth of sugar beet in New Zealand," by Dr. S. M. Curl. In this paper the writer very ably reviewed the subject and placed much valuable data before us; but, when speaking of the values of sugar in the different varieties of beet root examined by him, he claimed to have found as high as 17.5 per cent. This excessive amount, the fact that parliamentary papers had been published giving analysis of New Zealand grown beets showing much less favorable results, and the absence of any details of examination led me to take up this subject with the view of practical operations should the experiments justify it. About this period also, I had interested myself in the matter of sugar beet, owing to some superior seed having been brought from Hamburgh by Mr. G. S. Graham, and, finding it had been distributed amongst some of the Waikato settlers for planting, I undertook the examination of the roots when they should be sufficiently grown. Mr. W. A. Graham, of Tamahere, who had taken a very great interest in the matter, had papers printed according to a plan drawn out by myself, and forwarded to those settlers who had undertaken to grow the roots. These papers were designed to obtain data for the future guidance of a company, should one be formed through any satisfactory results of these experiments, and were divided into columns requesting information, as follows:

Particulars of Waikato beet roots.

From whom forwarded, and name of estate.
Character of soil, and whether drained, etc.
Whether manured or otherwise; if manured, state character of manure.
Whether from imported seeds or from where obtained.
Give approximate of weight to the acre, if possible.

Analytical results. Percentage of beet sugar and notes.

The first installment I received was from Mr. L. O'Neill, Hamilton, and came to hand on the 28th January. There were three roots, grown from seed imported by Mr. Lavers, and resulted as follows: No. 1, weight, 2 pounds 2 ounces; percentage of cane sugar, 10.95. No. 2, weight, 1 pound 2 ounces; percentage of cane sugar, 10.17. No. 3, weight, 12 ounces; percentage of cane sugar, 13.55.

On the 24th February, one month later, Mr. O'Neill again forwarded a parcel of four roots from the same crop. Taking the largest of them, weighing 2 pounds 2 ounces, I found the percentage of sugar to be 14.25; the three others I aggregated with a like percentage of 14.25.

Finally, on the 24th August, I received a parcel of five roots from the same grower, which had been removed from the ground and stored, some of which are on the table. Two of these I have examined with the following results: No. 8, weight, 2 pounds 7 ounces; percentage of sugar, 11.40. No. 9, weight, 2 pounds; percentage of sugar, 14.25.

The further examination of these roots I will speak of again, in relation to the specific gravity of the juice.

On the 18th of February I received three roots from Mr. Ralph, Huntley, marked sugar beet. They were of a full red-colored skin, but I have obtained no knowledge of the name of the seed or where procured. Result of analysis: No. 1, weight, 5 pounds 5 ounces; percentage of sugar, 4.31. No. 2, weight, 12 ounces; percentage of sugar, 7.50. No. 3, weight, 9 ounces; percentage of sugar, 11.87.

This root No. 1 was a well-shaped one, of large proportions, very watery, but with a very low percentage of sugar. This is the lowest result I have obtained, and far below any other. At the same time its excessive size would lead to the conclusion that its value in sugar was low.

One more parcel I received of unknown seed, from Raglan, through Mr. Will, comprising five small roots, badly formed, the largest of which, weighing 1 pound 12 ounces, yielded a percentage of sugar, 8.14.

I now proceed to note the results of the seed obtained by Mr. Graham from Hamburg, and which had been distributed as already noted. There were three kinds in all.

No. 1.—Genuine white small Wanziebenel imperial.

No. 2.—Deppe's pure white improved Silesian imperial.

No. 3.—Extra saccharine red-top imperial.

In the following notes I will simply call these varieties by their respective numbers, 1, 2, and 3.

On the 10th March I received three roots, one of each variety, from Mr. R. Watson, Pukerimu.

No. 1, weight, 13 ounces; percentage of sugar, 13.57. No. 2, weight, 1 pound 1 ounce, and No. 3 (weight, 12 ounces), I treated in the aggregate, with the result of 15 per cent. of sugar, this being the highest value obtained.

On the 2d of April I received a parcel of five roots from Mr. E. B. Walker, Cambridge, the weights of which were between 1 pound 1 ounce and 1 pound 15 ounces and were of the three varieties, but without anything to distinguish them. These I treated in the aggregate with the result of 13.57 per cent. of sugar. Taking the best proportioned root of the parcel, weight, 1 pound 10 ounces, I found it to contain 15 per cent. of sugar.

On the 10th August I received samples of the three kinds of root already named from Mr. T. Goodfellow, Alexandria, which gave the following results: No. 1, weight, 1⅛ pounds; percentage of sugar, 12.66. No. 2, weight, 1½ pounds; percentage of sugar, 11.40. No. 3, weight, 2¾ pounds; percentage of sugar, 9.82.

These roots arrived with the crowns removed. I had, therefore, no opportunity of observing whether there had been any late growth of leaves, but from the freshness of the roots and the results above quoted, I should think they had been left in the ground, and not dug up at maturity and stored.

I have now given the results of the examination of roots grown in the different parts of the Waikato, and will not unnecessarily multiply the details for you, but take as a last experiment the result of analysis of roots grown upon Mr. Graham's estate at Tamahere. It was my desire to examine these roots while they grew, and, if possible, to note the time at which they became matured, and on that account, the crop having been sown late, I received samples of the three varieties on the 8th February, resulting as follows: No. 1, weight, 1 pound 1 ounce; percentage of sugar, 8.90. No. 2, weight, 1 pound 6 ounces; percentage of sugar, 7.50. No. 3, weight, 3 ounces; percentage of sugar, 8.38.

These roots were immature, and consequently the results were low. On the 26th March I received another parcel of the three kinds from the same estate, yielding as follows: No. 1, weight, 1 pound 2 ounces; percentage of sugar, 10.55. No. 2, weight, 2 pounds; percentage of sugar, 11.87. No. 3, weight, 1 pound 7 ounces; percentage of sugar, 11.17.

On the 7th of May I visited the ground and chose samples of the three varieties which were still in the ground, rather overgrown with weeds and certainly having been left too long in the earth, the leaves still growing vigorously, the result no doubt of the late rains which had then been falling. Still they were fine roots, averaging from 1 to 3 pounds. They had been planted too far apart, and much space had been lost and room given for weeds to accumulate in. Being rather pressed for time I was unable to make a separate examination of these roots, and therefore I treated them in the aggregate with a result of 12.79 per cent. of sugar.

Finally, on the 29th August, I received samples of each variety fresh from the ground where they had still been allowed to remain, though fully 4 months had elapsed since they had reached maturity. These roots had been growing vigorously, a large crop of young leaves shooting up at the expense of the sugar stored up in the root. The result of the analyses, though low, has surprised me at the amount even yet left in the roots.

No. 1, weight, 2 pounds 9 ounces; percentage of sugar, 7.42. No. 2, weight, 2 pounds 4 ounces; percentage of sugar, 6.47. No. 3, weight, 3 pounds 5 ounces; percentage of sugar, 8.65.

Three of this parcel of roots were fowarded by Mr. Graham to Dr. Hector, Wellington, for analysis, with the result appended.

Results of analysis.—Three roots of sugar beet for sugar. Received 13th September, reported on 22d September, 1881: No. 1, weight, 1 pound 2 ounces; sugar per cent., 8.42. No. 2, weight, 1 pound 10 ounces; sugar per cent., 8.01. No. 3, weight, 2 pounds 10 ounces; sugar per cent., 6.94.

These are fairly good yields.

W. SKEY.

In reference to the methods of analysis and the sampling of the roots, I may remark that in every case, to insure a true average, I have punctured the root from crown to apex, taking the core for purposes of analysis, as it is a well-known fact that the sugar is not found in equal proportions throughout, the root being richer in sugar in the lower than in the upper portion. Having thus obtained a fair average of the root, I have accurately weighed and then pulped the assay portion in a mortar with distilled water, and inverted the sugar in the ordinary manner with dilute sulphuric acid, making my quantity up to a known amount, from which I have charged the burette in the ordinary way.

Fearful of the conversion of the woody fiber into glucose, and a consequent false increase of the results, I have frequently checked this process by filtering off the diffused juice from the pulp, well washing the latter, and then inverting the sugar contained, but in all these cases the pulp still retains a small amount of saccharine matter, but the difference between these two methods is so small as not to cause much disparity, and here I will give one experiment to show the difference. A root

of the red-top imperial weighing 2¾ pounds was taken, and two cores from the puncture tube fairly chosen, to the weight of 2 grams each, pulped, and the one inverted with the pulp, the second filtered, the pulp washed and the filtrate inverted, the percentages of sugar being 9.82 in the first portion and 9.50 in the second. The difference I attribute to the sugar still left in the pulp. The methods by which I have determined the percentages of sugar have been with Fehling's copper solution and Knapp's mercuric cyanide solution, both volumetric analyses, the former being in my opinion the most accurate. To insure precision, I have frequently inverted pure anhydrous cane sugar, and estimated my standard solutions with it, and therefore feel justified in saying that the analyses given by me in this paper are reliable.

In addition to the chemical analysis we have the specific gravity, this being a very reliable guide to the value of sugar present, and this I have obtained after expression of the juice on several occasions by means of the balance. Before concluding this portion of my paper on the chemical manipulations it will be interesting in a few cases to note the relative proportions between the chemical values and the specific gravities.

The root already mentioned as having been received from Mr. Walker, Cambridge, and which I estimated to contain 15 per cent. of sugar, was grated until it had lost weight equal to 200 grams, the juice from which being expressed equaled 128 cubic centimeters added water to the pulp and macerated, pressed to near dryness and made up the amount with water 200 cubic centimetres. Found the specific gravity of the pure juice before adding water to be 1.08087, and the percentage of cane sugar in the 200 centimeters to be 14.35, the difference being the amount of sugar still retained by the pulp. Again a root from Mr. O'Neil was grated, 1 pound of which yielded 14¼ ounces weight of juice and 1¾ ounces pulp. The specific gravity equaled 1.0528 and the percentage of sugar in the juice was 11.4.

One more experiment I will give, that of a root weighing 2 pounds, of which 14 ounces was grated, yielding 12 ounces juice and 2 ounces pulp, the specific gravity of the juice being 1.0653 and the percentage of sugar present 14.25.

There is one point in connection with this subject which deserves more than a passing notice, and that is in reference to the presence of chlorides, and especially that of chloride of sodium—common salt—this being so detrimental as to result in a loss of 5 per cent. of sugar for every 1 per cent. of the salt. When making my examination for sugar I have also tested for the presence of chlorine, but only to find a trace in any of the Waikato beet roots, with the exception of those now before you, which, having been left in the ground at least 4 months too long, are heavily charged with chlorides. One interesting feature is the absence, beyond a trace, of chlorides in the roots received from Raglan, already mentioned, and this though grown in the vicinity of the sea. I may state that I have not estimated the amount of chlorides, but simply as a qualitative test.

The distribution of the seed in the Waikato alone was in consequence of its distance from the sea and the very favorable situation and comparative absence of chloride of sodium from the pumice soil, but its cultivation in other portions of the Auckland district fairly deserves a trial.

The great objection to the presence of salt, either from the proximity to sea air, fertilization of the ground with it, or from an abnormal amount being naturally present, is owing to the impossibility of freeing the sugar from this substance, and in consequence the estimation of the chlorides is only second in importance to that of the sugar present. So inimical is this salt that M. Baruchson says: "In some instances the undue proportion of this salt in sugar has nearly rendered the sugar unsalable; and so generally is this recognized abroad, especially in Germany, that the manufacturers in contracting with the growers of the root stipulate that it shall not be grown on certain soils, and often even name the manure which shall be used." It is owing to this substance and the want of sufficient care in eliminating the molasses that beet sugar at one time was strongly objected to on account of the taste, and even

here I have heard complaints of the same character. . On this subject Grant, in his Beet Root Sugar, remarks: "There was formerly a prejudice in the minds of many people against beet sugar; but it is perfectly well ascertained that, if properly refined, it can not be distinguished from the best sugar of sugar cane, either by taste, appearance, or chemical analysis; the two are identical." Again, on page 24, he remarks: "The cost of producing from the beet a pure white sugar, entirely free from unpleasant smell or taste, is but a trifle more than is required to produce a low grade. In Germany refined loaf sugar is produced directly from the beet. In France the brown is first produced and then refined. Within the last two years, however, sugar has been produced of such purity and whiteness that it has been sold directly for consumption without refining; and there is no question that the peculiar odor of the beet may be entirely got rid of in the manufactory." I will quote one more authority on this subject, and that one of the highest we could have. I allude to Crookes, who says in his work Manufacture of Beet-Root Sugar: "Crystallized beet-root sugar is perfectly identical in composition with cane sugar and is indistinguishable from it by the sight, the taste, or by chemical tests."

Proceeding from the foregoing facts to summarize my results, I find that the value of sugar obtained from the whole of the roots examined by me last season under 3½ pounds in weight is a percentage of 11.66, but this average includes the immature ones from Tamahere, made when they were but half-grown, and also these roots now before us, which, having remained in the earth so many months after coming to maturity, have deteriorated considerably. If then we exclude these, the average result of the rest shows a percentage of 12.45; but, as some of the roots examined were practically too small for manufacturing purposes, I propose to exclude all under 1 pound weight, and thus reduce the average to roots between one and three pounds weight, this being a useful size for manufacturing purposes, large enough to pass safely through the washing machine without being lost or clogging the bars, and yet not too large to materially reduce the percentage of sugar. By this exclusion the average is 12.29, my highest being 15 and lowest 9.82.

In arriving at these results, I do so after a series of experiments extending over the past seven months, in which time I have made upwards of 80 analyses and examined more than 60 beet roots grown in different parts of the Waikato, many of them raised under very unfavorable conditions; some I found overrun with weeds, of others cattle had destroyed the leaves, while the majority were planted too far apart, and in almost all cases not sufficiently earthed-up, in consequence of which a portion of the sugar contained in the root, exposed to sun and air, becomes converted into other substances. Yet, notwithstanding all these disadvantages, the average of all the analyses made by me, with the exception of one root weighing over five pounds, was 11.66, while the exclusion of those which would under no circumstances be permitted to enter a sugar factory brought up the total to 12.45, an average return so favorable that it would result in a very large profit were it achieved in the countries where beet-sugar factories are established.

That these results are not exceptional is, I think, shown by the wide area over which I have obtained my supplies for examination; and that it will be fully equaled on the large scale is shown by the unskilled manner in which some of these roots were planted and tended, and also by the request, which in many instances was adhered to, that no manure should be used. So far from this, I feel convinced that, with due attention, proper cultivation, and suitable manuring, a higher percentage will be obtained than from those which the past season's growth has furnished us with; and, should a factory be established for the conversion of beet sugar, I believe the true economy of procedure would be in the purchase of roots at a fixed rate per ton, with an additional schedule price for every degree of sugar above a minimum, a practice which works beneficially amongst some of the German factories; especially would this be the case in the colonies, where the higher price of labor would naturally lead us to seek for the maximum of sugar from a minimum of root. It is not

within the scope of this paper to dilate upon the value to this district should such an industry find a home amongst us, but the benefits would be so great and varied, while the returns which I have now brought before you give so large a promise of success, that I hope the early future may find such an establishment situated where it would be most profitably worked—in the center of the Waikato district—where soil, temperature, and the absence of sea air proclaim its fitness for the growth of the beet.

PRODUCTION OF BEET SUGAR IN VARIOUS COUNTRIES.

The increase of the production of beet-root sugar in various parts of the world has led many to believe that it will eventually supersede sugar made from cane.

Some idea of the growth and extent of the industry can be formed from the latest estimated production of beet root in the various countries of Europe for this season as compared with the actual output of the two previous seasons:

Countries.	1884–'85.	1883–'84.	1882–'83.
	Tons.	*Tons.*	*Tons.*
France	430,000	475,000	423,194
Germany	1,100,000	985,000	848,124
Austria	525,000	445,000	473,002
Russia	340,000	310,000	284,491
Belgium	105,000	105,000	82,723
Other countries	50,000	40,000	35,000
Total	2,550,000	2,360,000	2,146,534

In 1878 the total production of all the countries in the world was 1,101,141 tons, which, as will be seen from the preceding table, is less than one-half of the amount of 1884.

In 1881 the output was 1,860,974 tons, in 1880 it was 1,403,929 tons, and in 1879 it was 1,574,153 tons. It will be seeu from Mr. Pond's paper that he quotes from Grant's works on Beet-Root Sugar to prove that the peculiar odor of the beet may be got rid of in the process of manufacture and that there is no difference between sugar made from the beet root and that made from the cane. Crooke's work is also cited to establish the fact that the two sugars are essentially the same. It should, nevertheless, be borne in mind that sugar cane is much richer in saccharine matter than the beet root. I am very well aware that within the last few years the methods of manufacturing sugar from the beet have been greatly improved, but I am also aware that improvements of equal or greater value have been applied to the manufacture of sugar from the cane.

BEET VS. CANE SUGAR.

Much stress is laid on the fact that the improved systems of modern agriculture have very greatly raised the yield of beet-root crops, but it is none the less true that the same systems of agriculture have increased in quite as high a degree the yield of the crops of sugar cane. Mr.

Steel, the analyst of the New Zealand Sugar Company, who has rendered me much valuable aid in the preparation of several reports for the Department of State at Washington on the sugar trade of this colony, has taken great pains to explain to me that, while cane crystallizable sugar is identical in all its properties whether derived from the sugar cane or beet root or from any other source, there are other circumstances which must be considered besides the mere identity of this substance when derived from different sources. For instance, I have learned from him that, associated with the crystallizable sugar, which is the sweetening element, there are naturally present in all sugar-producing plants other bodies which vary greatly in nature and amount in different plants, and which are more or less difficult to separate from the sugar according to their nature.

In the juice of the sugar cane the organic and inorganic impurities are exceedingly small in quantity and not of a nature to impart an objectionable flavor to the sugar; they are moreover comparatively easy of removal. In the beet root the opposite is the case. Here we have to deal with organic and saline impurities in very much greater proportion than is the case with the cane, and these impurities all accounts agree, have a most tenacious and objectionable flavor and smell. The amount of crop got from an acre of land is much greater in the case of cane than of beet. In Germany the yield of cleaned beets per acre may be fairly stated at from 10 to 12 tons. In Queensland and New South Wales the yield of cleaned cane, ready for crushing, is about 30 tons per acre at a low estimate for one-year-old cane, and for two-year-old it may be safely taken at from 50 to 60 tons. Here the cane has a decided advantage, even when we do not consider that it requires much less attention during its growth than the beet root. Again, as I have previously mentioned, the amount of sugar contained in the cane is greater than that present in the beet. From 11 to 13 per cent. is a fair allowance as to amount of sugar in the best beet root. In Australia the canes contain from 11 to 18 per cent. (generally about 14 or 16), according to the age and variety. Then, again, the beet crop has to be replanted after each harvest, while the sugar cane is habitually "ratooned" twice at least; that is, a second and third crop are obtained in succeeding seasons from the same old roots without any replanting.

The pulp resulting from the extraction of sugar from the beet is utilized as fodder for cattle. The begasse, the residue from the crushing of the cane, is in all modern and well-regulated sugar mills utilized as fuel, being burnt along with coal or wood in specially constructed furnaces. Of late considerable attention has been directed to the subject of utilizing the begasse in paper making. The chief impediment to its practical use is in the hard fiber from the joints of the canes, which is more difficult to pulp than that of the spaces between the joints. In refining the raw sugars produced from beet root and from cane the latter has important advantages over the former.

While there is no difficulty in the way of refining and disposing of the higher grades of raw beet-root sugar, when it comes to working up the lower products the matter assumes quite a different aspect. The impurities in this sugar consist of saline and organic bodies, having a most disagreeable taste and smell, and it is very generally admitted that these cannot be completely separated from the lower grades in the process of refining, and consequently the refined product retains more or less of them; besides, in working the lower grades of beet sugar, the accummulation of impurities renders it necessary to turn out the residual sirups, and this is done in the form of golden sirup. It is also admitted that the products of the cane can be worked to an infinitely further extent in the refining than those of the beet without the necessity of turning out sirup. On the other hand, the golden sirup produced from the residues of the refining of beet sugar has a most objectionable smell, and it is customary to mask this by the use of sulphuric acid, which gives a sharp, biting taste to the sirup. When cane-sugar residues are worked up into golden sirup the product is sightly and palatable, and of an entirely different flavor to that made from the beet sugar.

While it is difficult to distinguish between the higher grades of the refined products of the beet and cane, the lower grades are very palpably marked. The impurities in the two sugars, which differ so much in their properties, and which, as I have said previously, it is impracticable to remove, are, in the case of the beet root, of a particularly persistent nature. Many contend that the sweetening power derived from the beet, and particularly in the lower grades, is inferior to that derived from the cane. It is not disputed that the sweetness is not there, for it is there in exact proportion to the amount of cane or crystallizable sugar present, but it is maintained that the sweetness is masked by the flavor of the impurities inherent to the beet sugar, and hence the inferior sweetening power. The impurities, even in the very lowest qualities of cane sugar, are of quite a different nature, and do not tend to mask the intrinsic sweetening power of the sugar. If we taste a little of the lower grades of raw beet sugar we find that it has little or none of the characteristic flavor or sweetness of sugar, but possesses a very disagreeable, sickly, saline, oily taste. On the other hand, the lowest black "takas" or "concrete" sugars from the cane have always the strong sweet taste. In a modified degree this is precisely the difference between the refined products of the two sugars. The advocates of the cane-sugar industry state that the wasteful methods of extraction which have always been applied to the sugar cane have given the beet root, with the fostering care besowed upon it as an industry, a temporary advantage over its naturally more favored rival, and they confidently believe that it is only a matter of time when the cane will reassume its old position as the principal source of sugar. There is, however, one point in favor of the beet root which I have not mentioned, and that is the possibility of cultivating it in climates too cold for the sugar cane.

I am indebted to Mr. Steel for the following valuable tables showing the analyses of various kinds of representative raw sugars, including beet-root sugars, Australian-cane sugars, Fiji sugars, and sugars from Java, Formosa, and Tokyo, and the analyses of refined sugars, sirups, molasses, etc. These tables were prepared by Mr. Steel while employed in the refinery in this city and in various refineries in Europe, and have never hitherto been published.

Analyses of raw and refined sugars, etc.

BEET-ROOT SUGAR.

Crystallizable sugar	96.00	95.00	94.00	94.00	93.60	91.20	90.50
Other organic matters	1.31	1.10	1.32	1.71	1.41	2.27	2.50
Ash (saline matters)	1.19	1.15	1.17	1.39	1.64	2.23	2.45
Water	1.50	2.95	3.50	2.90	3.35	4.30	4.55
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net titre	90.05	89.25	88.15	87.05	85.40	80.05	78.25
Crystallizable sugar	92.00	91.00	88.40	88.50	86.00	86.00	86.60
Other organic matters	2.21	2.66	2.84	3.24	3.39	3.43	3.20
Ash (saline matters)	2.99	3.04	3.11	4.01	4.06	4.32	4.75
Water	2.80	3.30	5.65	4.25	6.55	6.25	5.45
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net titre	77.05	75.80	72.85	68.45	65.70	64.40	62.85

BEET-ROOT SUGARS CONTAINING FRUIT SUGAR.

Crystallizable sugar	89.20	88.20	87.50
Fruit sugar	1.82	2.15	1.97
Other organic matters	2.20	2.45	3.29
Ash (saline matters)	2.43	2.60	2.74
Water	4.35	4.60	4.50

CANE SUGARS.

	Australian sugars.						
Crystallizable sugar	96.20	95.50	93.70	92.00	90.60	89.50	82.20
Fruit sugar	.96	1.90	1.17	2.08	3.81	4.12	5.88
Other organic matters	1.16	.75	1.72	2.09	1.48	1.74	4.53
Ash (saline maters)	.76	.66	1.18	1.69	1.39	1.53	2.75
Sand							
Water	.92	1.19	1.73	2.14	2.81	3.11	4.64
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net titre	91.44	90.30	86.13	81.47	80.29	77.73	62.57

	Fiji sugars.				Java sugars.			
Crystallizable sugar	95.90	92.40	89.70	87.30	97.20	95.10	94.50	92.30
Fruit sugar	1.12	2.63	3.29	3.69	.85	1.75	2.45	3.63
Other organic matter	1.01	1.43	1.90	2.80	.85	1.16	.97	1.15
Ash (saline matters)	.34	.67	1.14	1.28	.21	.33	.33	.40
Sand	.04	.03	.05	.05	.06	.07	.07	.13
Water	1.59	2.84	3.92	4.88	.83	1.59	1.68	2.39
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net titre	93.08	86.42	80.71	77.21	95.30	91.70	90.40	86.67

CHINA SUGARS.

	Formosa sugars.			Ilo-Ilo.	Takao sugars.		
Crystallizable sugar	80.00	80.00	76.70	82.10	80.60	78.50	76.30
Fruit sugar	7.13	7.38	8.56	6.29	7.02	5.69	2.26
Other organic matters	2.84	3.97	5.93	4.47	4.04	5.11	3.47
Ash (saline maters)	2.18	2.66	2.68	2.30	1.42	2.59	2.79
Sand	.30	.14	.20	.24	.09	.48	.20
Water	7.55	5.85	5.93	4.60	6.83	7.93	8.98
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net titre	61.97	59.32	54.74	64.31	66.48	61.36	54.09

REFINED SUGARS.

	Loaf sugar.	First white.			First counters.			Yellow.		
Crystallizable sugar.	99.50	99.30	98.20	97.70	96.20	94.10	93.30	87.70	85.60	85.40
Fruit sugar	.10	.16	.47	.57	1.05	2.57	3.10	6.34	8.10	7.85
Other organic matters	.14	.20	.12	.35	.49	.83	.53	1.38	1.45	1.67
Ash (saline matters).	.02	.02	.04	.05	.12	.31	.38	1.00	1.28	1.17
Water	.24	.32	1.17	1.33	2.14	2.19	2.69	3.58	3.57	3.91
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SIRUP AND MOLASSES.

	Golden sirup.		Raw beet molasses.	Raw cane molasses.	
Crystallizable sugar	39.50	27.80	48.80	51.14	46.02
Fruit sugar	28.57	35.71	.54	7.54	12.93
Other organic matters	9.61	13.55	23.22	14.18	10.34
Ash (saline matters)	5.27	5.47	10.94	9.79	11.36
Water	17.05	17.45	16.50	16.65	19.35
	100.00	100.00	100.00	100.00	100.00

Before studying the preceding tables it is well enough to explain that crystallizable sugar is the body to which the sugar owes its sweetness. It is known by various other names, such as sucrose, cane sugar, etc. Fruit sugar is glucose or uncrystallizable sugar. The net titre is the theoretical amount of pure loaf sugar which would be obtained were the sugar refined up entirely into loaf sugar and sirup. It is merely, however, an empirical figure, and its use is solely for comparative purposes, for which it is of great value. It is based on the assumption that each 1 part of ash prevents 5 parts of crystallizable sugar from crystallizing, holding it in solution as sirup; and that each 1 part of fruit sugar has the crystallization of its own weight of cane sugar. Therefore, to find the net titre or theoretical available percentage of sugar in any sample, we multiply the ash by 5, add on the fruit sugar, and deduct the total from the crystallizable or cane sugar; the result is the net titre.

On the examination of the table of analyses it will be seen that cane sugar is superior to the product of the beet in net titre. Thus, a cane sugar containing 90.60 per cent. of crystallizable sugar has a net titre

of 80.29 per cent., while a beet-root sugar has a net titre of 80.05 per cent. This holds good throughout the whole series. These analyses of beet-root sugar, Mr. Steel informs me, are fair representatives of the sugar of this class imported to the Greenock refineries. The analyses of cane sugars will give an idea of the composition of the sugar from the main sugar-producing districts imported into Australia. The refined sugars are average products of a refinery working cane sugar. The golden sirup was made in a refinery in Greenock, working a mixture of beet and cane sugars. The composition of the molasses from the beet and cane factories varies exceedingly according to the system of working. Beet-root sugar seldom contains any fruit sugar.

G. W. GRIFFIN,
Consul.

UNITED STATES CONSULATE,
Auckland, December 1, 1884.

SUGAR IMPORTS AND EXPORTS OF THE UNITED STATES.

Imports and exports of sugar into and from the United States during the fiscal year 1890.

[Commerce and Navigation for the year 1890—Bureau of Statistics, Treasury Department.]

IMPORTS—DUTIABLE.

Countries from which imported.	Molasses.		Sugar, Dutch standard in color (not above No. 13, and tank bottoms, sirups, melada, etc.).			
			Beet sugar.		Cane, and other.	
	Gallons.		*Pounds.*		*Pounds.*	
Austria-Hungary	.....	.....	60, 591, 333	$1, 577, 244	.....	.....
Belgium	.....	.....	19, 329, 390	498, 858	.....	.....
Brazil	.....	.....	.....	.....	73, 800, 970	$1, 659, 251
Central American States:						
Guatemala	.....	.....	.....	.....	583 934	24, 331
Salvador	.....	.....	.....	.....	1, 876, 450	69, 846
China	.....	.....	.....	.....	606, 644	15, 407
Danish West Indies	78, 244	$11, 371	.....	.....	13, 642, 707	474, 893
France	34	53	844, 956	21, 019	729, 092	23, 935
French West Indies	.....	.....	.....	.....	4, 074, 480	124, 248
Germany	.....	.....	512, 009, 173	16, 031, 431	2, 411, 584	65, 794
England	268	78	5, 958, 944	167, 104	23, 587, 254	763, 889
Scotland	.....	.....	.....	.....	22, 400	546
Nova Scotia, New Brunswick, and Prince Edward Island	86, 648	23, 687	.....	.....	1, 556, 238	55, 828
Quebec, Ontario, Manitoba, and the Northwest Territory	9, 983	2, 226	.....	.....	717, 086	48, 328
British Columbia	.....	.....	.....	.....	192	6
British West Indies	2, 119, 049	320, 430	.....	.....	291, 306, 725	8, 589, 677
British Guiana	7, 213	834	.....	.....	135, 971, 015	4, 323, 702
British Honduras	.....	.....	.....	.....	391, 144	11, 456
Hong-Kong	14	1	.....	.....	29, 367	681
British possessions in Africa and adjacent islands	.....	.....	.....	.....	16, 002, 445	381, 898
Mexico	7	6	.....	.....	747, 012	27, 015
Netherlands	.....	.....	2, 385, 680	52, 761	.....	.....
Dutch Guiana	73, 863	7, 680	.....	.....	3, 422, 571	103, 694
Dutch East Indies	.....	.....	.....	.....	111, 929, 287	2, 722, 320
San Domingo	400	96	.....	.....	47, 033, 940	1, 715, 364
Spain	.....	.....	.....	.....	.....	.....
Cuba	24, 918, 292	3, 679, 076	.....	.....	1, 041, 072, 929	35, 420, 441
Porto Rico	4, 106, 368	1, 110, 473	.....	.....	76, 926, 934	2, 750, 774
Philippine Islands	15, 415	3, 469	.....	.....	259, 775, 540	6, 814, 397
Turkey in Europe	2	1	.....	.....	.....	.....
Venezuela	.....	.....	.....	.....	218	5
Total	31, 415, 800	5, 159, 481	601, 119, 476	18, 348, 417	2, 108, 218, 158	66, 187, 726

FROM THE HAWAIIAN ISLANDS—FREE OF DUTY.

	Quantity.	Value.
	Gallons.	
Molasses	81,443	$9,314
Sugar, brown	224,457,011	11,549,828
All other	....	861

EXPORTS.

Countries to which exported.	Molasses and sirup.		Sugar, brown.		Sugar, refined.		Candy and confectionery.
	Gallons.		*Pounds.*		*Pounds.*		
Argentine Republic	50	$30	.....	.....	347	$25	.....
Austria-Hungary	.....	.....	.....	.....	.....	.....	.....
Belgium	165,007	27,690	.....	.....	.....	.....	$10
Brazil	.....	.....	.....	.....	8,491	600	200
Central American States:							
Costa Rica	349	151	28,754	$1,880	155,158	11,617	6,252
Guatemala	.....	.....	8,120	480	34,576	2,546	1,645
Honduras	53	28	16,165	967	208,294	15,757	418
Nicaragua	2,027	478	45,931	2,743	304,419	22,004	542
Salvador	.....	.....	.....	.....	532	44	472
Chile	801	201	.....	.....	1,263,415	87,947	26
China	.....	.....	.....	.....	9,438	803	595
Colombia	334	220	10,856	641	1,816,928	141,929	2,266
Denmark	183,438	37,456	.....	.....	15,115	1,302	.....
Danish West Indies	.....	.....	.....	.....	305,854	22,501	304
Ecuador	.....	.....	.....	.....	2,785	213	205
France	.....	.....	.....	.....	750	54	23
French West Indies	100	19	.....	.....	10,169	768	.....
French Guiana	.....	.....	.....	.....	59,534	4,329	.....
Miquelon, Langley, Saint Pierre Islands	8,716	2,185			450,538	28,138	781
French possessions in Africa and adjacent islands	.....	.....	.....	.....	2,803	116	.....
French possessions in Oceanica	.....	.....	.....	.....	316,980	23,272	375
Germany	272,116	56,147	675	40	147,353	9,984	754
England	2,670,890	388,790	1,702	180	5,688,627	368,574	41,565
Scotland	2,013,602	275,190	.....	.....	1,502,394	105,648	11,135
Ireland	82,159	8,395	.....	.....	.....	.....	.....
Novia Scotia, New Brunswick, and Prince Edward Island	14,990	4,083	.....	.....	182,691	12,129	2,533
Quebec, Ontario, Manitoba, and Northwest Territory	222,719	42,649	82,000	4,612	311,550	14,394	17,898
British Columbia	28,863	8,698	.....	.....	169,275	10,628	2,389
Newfoundland and Labrador	1,280	275	.....	.....	256,276	16,885	2,286
British West Indies	275	97	1,788	127	1,713,090	136,417	8,709
British Guiana	.....	.....	.....	.....	2,422	205	34
British Honduras	360	164	5,020	310	96,208	7,062	259
British East Indies	.....	.....	.....	.....	4,968	417	1,316
Hong-Kong	.....	.....	.....	.....	3,910	265	105
British possessions in Africa and adjacent islands	930	362	.....	.....	425,063	33,619	50
British possessions in Australasia	11,030	2,079	.....	.....	7,097,629	487,000	10,415
British possessions, all other	440	140	1,000	90	.....	.....	.....
Hawaiian Islands	1,340	299	.....	.....	1,280,819	91,833	3,843
Haiti	.....	.....	.....	.....	1,665,188	129,714	2,369
Italy	.....	.....	.....	.....	500	40	5
Japan	.....	.....	.....	.....	186,317	14,580	392
Liberia	10	7	.....	.....	36,035	2,555	12
Mexico	261	123	5,456	448	541,481	41,464	4,660
Netherlands	.....	.....	.....	.....	69,769	5,493	.....
Dutch West Indies	20	8	.....	.....	145,343	11,317	1,147
Peru	51	18	.....	.....	.....	.....	1,524
Portugal	.....	.....	.....	.....	4,041	280	.....
Azore, Madeira, and Cape Verde Islands	2,054	486	.....	.....	242,704	15,786	58
Russia on the Baltic and White Seas	20,619	3,496	.....	.....	.....	.....	.....
San Domingo	40	10	.....	.....	251,655	19,098	1,437
Cuba	20	8	.....	.....	1,229	110	27,752
Porto Rico	.....	.....	.....	.....	10,921	828	5,289
Spanish possessions in Africa and adjacent islands	.....	.....	.....	.....	2,415	150	.....
Sweden and Norway	329,614	76,176	.....	.....	.....	.....	.....
Uruguay	300	69	.....	.....	5,070	450	.....
Venezuela	.....	.....	.....	.....	1,455	121	17,073
All other countries and ports in Africa	10	6	.....	.....	3,050	209	.....
All other islands and ports	.....	.....	.....	.....	2,428	166	153
Total	6,034,868	936,233	207,467	12,518	27,018,002	1,901,386	179,276

PART II.

FLAX CULTIVATION.

FLAX CULTIVATION.

THE FLAX INDUSTRY OF RUSSIA.

REPORT OF CONSUL-GENERAL CRAWFORD, OF ST. PETERSBURG.

ANTIQUITY OF FLAX AND LINEN.

The cultivation of flaxseed in Europe, and the spinning and weaving, by the most primitive means, of fine linen would seem to antedate history. As far back as the Stone Age the inhabitants of Switzerland and of Lombardy, living in huts and feeding upon roots and acorns, were familiar in a crude way with this industry. It is in evidence also that before the appearance of the Aryans west of the Ural Mountains the Finns cultivated flax to a considerable degree in the north of Europe. Historical memoirs prove that the ancient Hindoos and Egyptians produced flax, the former for its seed, the latter, about 5,000 years ago, for its thread.

The Egyptian linen must have reached a very high degree of perfection, as Herodotus, in enumerating the presents made to the Emperor Amasis, of Athens, speaks of garments made of flax a single thread of which consisted of three hundred and sixty finer threads. According to Pliny, Tacitus, and other Roman authors, the cultivation of flax flourished in northern Italy, Gaul, Germany, and with the ancient Finns, and more especially with the Celts early settled in Ireland.

The history of the flax industry in Russia dates from the discovery of the country. In his "Life of Theodore Petchersky" Nestor states that the monks produced oil from flaxseed, and made for themselves a "strong" linen from the filaments of the stalks. The importance of flax among the early Lithuanians is evidenced by the fact that in their mythology they worshiped a special deity who presided over this industry.

Peter the Great interested himself largely in furthering the cultivation of flax in Russia. In a ukase December 13, 1715, he ordered that in all the provinces the peasants should plow an increased acreage each year to be sown with flax and hemp.

As early as the first half of the present century the cultivation of flax occupied a considerable acreage in Russia, which has gradually increased to the present day, as shown by the fact that notwithstanding the in-

creased consumption at home, the exportation of flax increased from 43,942 tons in 1824 to 76,333 tons in the year 1848. But the emancipation of serfs in Russia gave the greatest impetus to this industry. Although this event obliged many proprietors to abandon large portions of arable land, much of which had been sown with flax, still many of the freed peasants willingly undertook to till the lands abandoned by the proprietors as well as to open up new fields to this branch of agriculture, also to increase the acreage of land sown with flax in the provinces of Pskofv, Smolensk, Tver, Kostroma, and some others.

In 1881, according to information published by the central bureau of statistics, in Russia in Europe, excepting the Polish provinces and Finland, there were 3,776,287 acres under flax, and divided as follows: 2,668,550 acres belonged to the peasants, 1,107,737 acres belonged to proprietors.

It is very difficult to state the exact acreage of land sown with flax belonging to the peasants, because it is dispersed over all the empire; but the figures given above must be considered as underestimated.

Concerning the different acreages sown with flax for the last 7 years, it must be said that no definite information exists, inasmuch as that obtained by the central statistical committee in 1886 has not yet been published, but from the data given to the Imperial Agricultural Department by proprietors we may conclude that until 1884, thanks to the high price of wheat, the cultivation of flax in many districts decreased, whereas in the last 2 or 3 years it has again increased and the cultivation of flax is once more one of the most lucrative products of Russian agriculture, especially as this product has not suffered any decline in prices. On this account the flax producers of the Baltic provinces have taken this industry up again. In many other places the same movement has been noticed, so that it is proper to suppose that at the present time the acreage sown under flax is considerably larger than that of 1881. In the district of Gjatsk, province of Smolensk, for example, twice as much land was sown to flax in 1888 as in the previous year.

FLAX CROP OF 1888.

The general crop of flaxseed in the black soil provinces was satisfactory; the east of Russia, and especially the provinces of Orenburg, Oufa, Samara, and Saratoff were an exception, where this crop was as unsatisfactory as that of spring wheat, and for a similar reason.

In the common-soil provinces of Russia this crop was above the average in the western provinces excepting that of Vitebsk, and it approached the average in the Baltic provinces, as well as those of the north and nothwest. In some places of the industrial provinces flaxseed was completely destroyed by a species of butterfly, and therefore the crop was unsatisfactory. In the central Volga provinces and the trans-Volga forest lands the crop was also below the average.

Statement showing the flaxseed crop per deciatine (2.7 acres) in the black-soil and common-soil provinces for 1888 compared with that of the two previous years.

Districts.	Average crop.					
	Proprietors.			Peasants.		
	1886.	1887.	1888.	1886.	1887.	1888.
BLACK-SOIL PROVINCES.						
Southern sandy soil.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Besarabia	17¼	26	18	13	27	12¼
Kherson	29¾	19	9¾	19¾	20	6½
Tauride	5¼	19	13	6	16	11
Ecatherinoslaw	20½	23	4	.....	19	4
Don district	27	16½	8½	.....	15	9
Central black-soil provinces.						
Poltava	43¾	29	17½	43	26	21¾
Kharkow	28¼	26	16	30¼	23	9
Voronej	38½	32	9¾	19¼	30	6½
Southwestern provinces.						
Kieff	52¾	22½	20½	.....	15½	20
Podolia	.....	12½	11	.....	8	5
Vohlonya	22	22	19	22	17½	14¾
Northern black soil.						
Koursk	42½	27	16	.....	29¼	16¾
Tchernigow	27¼	17	16	.....	16¾	18¾
Orloff	27	22	21¾	.....	23	19¾
Tamboff	39¼	27	13½	27¾	21	13
Toula	36	24	24½	32¼	20	17½
Riazan	25¾	20	18¾	27½	18	19¼
Penza	29	21	18¾	25¾	20	18
Eastern and southeastern.						
Kazan	21¼	21	16¾	20¼	18¼	16
Simbirsk	27½	20½	22½	24½	16½	17½
Saratoff	23	17½	16¾	24	12	14¼
Samara	31	14	16	24	18	9¾
Oufa	11½	14½	13½	14¾	14½	15½
Orenburg	21¼	9½	.....	32	10¾	12¼
Astrakhan	.....	6½	.....	.....	11	.....
COMMON-SOIL PROVINCES.						
Industrial provinces.						
Moscow	20¼	13	19¼	.....	8½	18
Tver	17¼	9½	13	17	8	14
Vladimir	17¼	7	13	17¼	7½	13½
Yaroslaw	13½	6¾	11½	17	7	11½
Smolensk	18	12	16	19¼	12	15½
Kalouga	19¼	10	18	19¾	8½	18
Western provinces.						
Kovna	11½					
Vilna	13½	16¼	14¾	11	15½	15
Vitebsk	11	12	7¾	13½	13½	14
Grodno	.....	9	9¾	7¾	9¼	9¾
Minsk	13	16	14¾	.....	19¼	13
Mohilieff	13½	15¾	15½	11½	14	15½
Central Volga and trans-Volga forest land.		16	20	19¼	17½	18¾
Nijni-Novgorod	.....	12¼	18	.....	10¾	16
Kostroma	17½	7	11½	16	7	9¾
Viatka	16	11½	12¼	24¼	9½	11
Perm	15½	14¼	12¼	13½	11	15½
Northwestern.						
St. Petersburg	.....	12½	12¼	.....	11½	13
Pskoff	7¾	6¼	6	7	7¼	7
Novgorod	16¾	9½	11	14¼	9¾	11
Baltic provinces.						
Courland	13½	20	19	12¼	16¾	16¾
Lifland	14¾	14½	14	14	10½	12¼
Eastland	.....	13½	.....	.....	12¼	12¼
Northern.						
Vologda	13½	10¼	10¼	15½	10½	10¼
Olonets	.....	14¾	11	.....	8¾	9¾
Archangel	.....	14¾	.....	.....	11½	9

As no average is given for the Polish provinces, I therefore infer that flax was only produced in the provinces of Kalisch and Souvalsk, where it rendered 36 pounds per acre with the proprietors and 66 English pounds with the peasants.

The total yield of flaxseed in 1888.

Districts.	Quantities.	Districts.	Quantities.
BLACK-SOIL PROVINCES.		COMMON-SOIL PROVINCES—continued.	
South sandy lands.	*Bushels.*	*Industrial*—Continued.	*Bushels.*
Besarabia	354, 554	Yaroslaw	284, 076
Kherson	1, 204, 839	Smolensk	401, 262
Tauride	699, 452	Kalouga	153, 135
Ecatherinoslaw	1, 205, 630	Total	1, 725, 754
Don district	1, 758, 676		
Total	5, 223, 151	*Western.*	
Central.		Kovna	782, 847
Poltava	645, 459	Vilna	290, 509
Kharkow	313, 172	Vitebsk	330, 790
Voroney	570, 260	Grodno	172, 597
Total	1, 528, 891	Minsk	300, 677
Southwestern.		Mohiliew	87, 596
Kieff	31, 142	Total	1, 965 007
Podolia	8, 830		
Volhynia	136, 259	*Central Volga and Transvolga.*	
Total	176, 231	Nijni-Novgorod	370, 050
Northern.		Kostroma	352, 297
Koursk	17, 362	Viatka	809, 587
Tchernigow	189, 727	Perm	469, 396
Orel	95, 850	Total	2, 001, 330
Tamboff	962, 210	*Northwestern.*	
Toula	67, 425	St. Petersburg	105, 107
Riazan	251, 060	Pskoff	475, 369
Penza	514, 016	Novgorod	177, 103
Total	2, 087, 650	Total	757, 579
Eastern and southeastern.		*Baltic.*	
Kazan	278, 968	Courland	817, 161
Simbirsk	154, 866	Lifland	201, 563
Saratoff	466, 242	Eastland	34, 373
Samara	366, 972	Total	1, 053, 037
Oufa	164, 255	*Northern.*	
Orenburg	134, 071	Vologda	228, 147
Astrakhan	36, 878	Olonets	35, 504
Total	1, 602, 252	Archangel	18, 290
Total in black-soil provinces	1, 618, 252	Total	281, 941
COMMON-SOIL PROVINCES.		Total crop of common-soil provinces	7, 784, 648
Industrial.		Total crop of Russian Empire	18, 402, 823
Moscow	133, 708		
Tver	380, 693		
Vladimir	372, 880		

From the data obtained from the central statistical bureau, grouped in the following table, it will be seen that in the 50 provinces of Russia in Europe, flax covered about 42 per cent. of the land sown in the black-soil provinces, and about 60 per cent. of that of the common-soil provinces. Although the greatest part of land sown to flax in the common-

soil provinces is sown by peasants upon lands rented by them from the proprietors, nevertheless, the peasants sow to flax 72 per cent. of their own lands in the black soil, and 86 per cent. in the common-soil provinces.

Land sown under flax in Russia.

Provinces.	Total sown under flax.			Percentage of flax sown to total acreage sown.				
				Peasants' lands.		Proprietors' lands.		
	Peasants' lands.	Proprietors' lands.	Total.	Average.	Variations.	Average.	Variations.	
BLACK SOIL.	*Acres.*	*Acres.*	*Acres.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Besarabia	22,110	22,555	44,665	0.9	0.0 to 2.7	1.9	0.6 to 7.0	
Kherson	43,467	120,922	164,389	1.2	0.0 4.9	3.8	2.1 6.0	
Catherinoslaw	101,476	151,251	252,727	2.9	0.2 5.4	3.8	4.3 13.5	
Tauride	48,645	68,960	117,605	1.6	0.0 6.5	7.4	0.0 26.2	
Don District	156,759	105,931	262,690	2.4	0.6 10.7	4.5	2.0 9.7	
Varonef	14,088	43,254	57,342	0.3	0.0 1.3	3.0	0.0 9.1	
Kharroff	10,035	25,641	35,676	0.2	0.0 0.8	2.1	0.0 4.1	
Poltava	9,487	48,402	57,889	0.3	0.0 1.3	2.3	0.0 7.3	
Kieff	1,944	3,315	5,259	0.1	0.0 0.3	0.2	0.0 0.7	
Podolia	818	2,400	3,218	.....	0.0 0.1	0.1	0.0 0.4	
Volhynia	15,846	5,867	21,713	0.6	0.0 0.4	0.4	0.0 1.7	
Koursk	1,277	656	1,933	.....	0.0 0.2	.....	0.0 0.3	
Tchernigow	24,734	6,523	31,257	1.0	0.2 3.6	0.5	0.0 1.7	
Oreol	10,956	1,336	12,292	0.4	0.0 1.1	0.1	0.0 0.8	
Tambow	63,396	40,313	103,709	1.5	0.0 3.4	2.0	0.2 6.0	
Toula	11,318	640	11,958	0.6	0.0 2.6	.....	0.0 0.2	
Riaxan	35,116	2,192	37,308	1.5	0.0 4.0	0.2	0.0 0.9	
Penza	28,868	3,474	32,342	1.2	0.2 3.6	0.3	0.0 0.5	
Astrakhan	10,073	224	10,297	1.4	0.0 4.9	0.3	0.0 0.3	
Kazan	40,357	462	40,819	1.0	0.3 2.8	0.1	0.0 0.2	
Simberia	17,958	4,344	22,302	0.9	0.1 4.0	0.4	0.0 5.0	
Samara	50,711	16,335	67,046	0.9	0.1 1.5	1.9	0.0 3.7	
Orenburg	35,632	3,772	39,404	1.1	0.2 1.3	1.2	0.2 1.7	
Saratoff	27,057	43,562	70,619	0.7	0.0 1.7	2.2	0.0 6.9	
Oufa	25,046	2,049	27,095	0.7	0.5 1.1	0.4	0.2 1.8	
Totals	807,174	724,380	1,531,554	0.9	0.0 10.7	1.8 0.0	0.0 26.2	
COMMON SOIL.								
Moscow	32,524	1,320	33,844	2.4	0.2 7.3		0.0 5.8	
Tver	95,718	17,923	113,641	4.6	2.1 11.5	5.6	1.0 13.6	
Vladimir	138,788	10,044	148,832	6.5	0.9 16.2	3.2	0.0 10.5	
Yaroslaw	91,236	13,659	104,895	7.3	3.8 11.9	7.1	3.4 10.7	
Smolensk	84,540	13,647	98,187	4.5	2.3 10.5	3 8	0.2 18.0	
Kalouga	38,661	2,076	40,737	2.4	1.5 4.0	0.5	0.0 2.4	
Kovna	108,818	27,780	136,598	7.3	3.8 9.5	3.6	2.0 6.4	
Vilna	43,408	15,398	58,806	2.8	1.3 6.2	2.0	0.5 5.2	
Grodno	20,722	2,643	23,365	1.4	0.6 3.0	0.4	0.2 1.0	
Vitebsk	72,578	25,369	97,947	5.5	1.7 10.0	5.8	2.3 7.8	
Minsk	39,298	13,265	52,563	2.0	1.5 2.9	1.3	0.4 2.6	
Mohilieff	36,882	7,198	44,080	2.5	1.5 4.0	1.5	0.2 4.9	
Kostroma	142,603	7,776	150,379	6.3	1.9 15.8	3.9	1.1 12.1	
Niji Novgorod	107,174	6,512	113,686	4.3	2.3 9.6	0.9	0.1 10.5	
Viatka	246,507	948	247,455	3.2	2.0 6.8	1.6	0.0 5.1	
Perm	92,479	7,935	100,414	2.4	1.2 3.1	2.0	0.6 7.2	
St. Petersburg	27,167	3,388	30,555	3.9	0.2 8.2	2.2	0.0 5.5	
Pskov	170,859	49,531	220,390	13.3	2.0 17.9	12.9	3.7 19.0	
Novgorod	43,339	6,169	49,508	2.7	1.6 4.5	1.7	0.5 5.3	
Lifland	120,652	59,651	180,303	13.8	0.8 18.6	9.3	0.2 14.6	
Courland	30,021	4,047	34,068	4.1	1.7 11.7	1.0	0.3 3.9	
Eastland	5,535	1,828	7,363	1.8	1.3 2.4	0.6	0.3 1.3	
Archangel	3,804	40	3,844	2.4	0.0 14.3	0.4	0.0 1.1	
Vologda	54,224	12,817	67,041	4.4	1.1 11.7	6.1	0.0 9.5	
Olenets	11,610	232	11,842	3.4	0.8 13.5	1.5	0.0 8.5	
Total	1,859,147	311,196	2,170,343	4.6	0.0 18.6	3.2	0.0 19.0	

The reason why the peasants of the common soil provinces, rather than those of the black soil provinces, push the cultivation of flax may be summed up as follows:

In the black soil provinces, where flax is generally cultivated for the seed, it requires virgin land or plowed fields which have remained idle for some time. This requisite is rarely to be found among the peasants, and it often happens that the flax crop is not more valuable than that of wheat or other cereals. On the other hand, in the common soil provinces, with the existing system enforced by the landowners, the cereal crops are generally so poor, that the peasants have difficulty in supporting their families, and therefore they are obliged to devote themselves to other means of livelihood and nothing is left more lucrative in agriculture than the cultivation of flax, especially in the northern regions.

Flax grown for the fiber is raised satisfactorily in ordinary plowed fields, but gives more abundant and a better quality of fiber when sown in waste ground or ravines, having a rich surface soil, thus enabling the farmer to utilize lands not suited to the growth of cereals proper.

Again, in cultivating flax seed, the principal expenses of the proprietor are the rental of land and the labor on the same—that is to say, the same category of expenses, and generally in the same proportion, as for the cultivation of cereals. The production of flax for the fiber, however, demands, besides the work in the fields, nearly five times as many working days to prepare the fiber properly as for the cultivation of the seed.

A landowner of the province of Novgorod states that the cultivation of a deciatine (2.7 acres) of land requires 13 days labor with a horse and 45 days hand labor, and for the working of the fiber it takes 229 days hand labor. It is generally considered that each deciatine of land with an average crop of flax requires from 100 to 150 days of work, of which 25 to 35 are in the field and the remaining 75 to 115 in the preparation of the fiber.

The flax industry requires great pains and hard work, and is therefore less profitable to the proprietors than to the peasants, as it gives the latter occupation outside the field labor and during the winter season. Besides, to grow a good quality of flax-fiber, and to prepare and hatchel it properly, necessitates both patience and skill, so much so that the proprietors who have to hire their laborers often suffer great losses on this account. Therefore, many proprietors of the flax-growing provinces prefer to rent out their land to the peasants for the cultivation of flax, reserving for themselves such land only as can profitably be sown to cereals and potatoes. It often happens that a high price is paid for the rental of land suitable for the cultivation of flax, exceeding in some cases the original value of the land. For instance, in the province of Pskov the average price for the rental of land is between 25 and 50 rubles per deciatine, attaining even the price of 80

rubles per deciatine and even higher in other localities of the Pskov and Ostrow districts, the average rental of flax land in these districts from 1870 to 1880 being about 33 rubles per deciatine.

From the foregoing tables it is furthermore seen that the flax is cultivated in every province, but with varying degrees of success. Of the black-soil provinces, that of Koursk had only sown 716 deciatines under flax, and the amount of land sown with flax in the provinces of Podolia, Kieff, Astrakhan, Toula, Orel, Volhynia, Simberia, and Oufa did not exceed 10,000 deciatines; from 10,000 to 20,000 deciatines of land were sown to flax in the provinces of Tchernigow, Penza, Kharkow, Riazan, Orenburg, Kazan, and Besarabia; about 40,000 deciatines in the provinces of Vorony, Poltava, Samara, Saratoff, and Tamboff; and lastly, more than 45,000 deciatines of land in the provinces of Tauride, Kherson, Ecatherinoslaw, and the Don districts. In general, the principal center of flax cultivation in the southern region of the Empire is restrained to the sandy and central black-soil provinces. The extension of this industry varies also very greatly in the provinces. Some districts do not cultivate flax at all, whereas in the neighboring district of the same province the cultivation of flax exceeds 10 per cent. of all the land sown.

It appears that in the common soil provinces, there are only two districts where the flax industry is entirely wanting; these are the districts of Archangel and Kemsk, situated on the coast of the Frozen Sea. The amount of land devoted to the cultivation of flax in the districts of Mezen and Onega, does not exceed 150 acres. The very small quantity of flax grown also in the districts of Povienetz, province of Olenets, in the vicinity of St. Petersburg and in several other places is explained by the fact that in these places the industry has neither an industrial value, nor are the laborers in these districts competent to satisfy the demands of the market as to quality. But in general, the cultivation of flax in the common soil provinces shows itself more evenly distributed than in the black soil provinces, where it is not cultivated for its fiber, which is so necessary to the peasants for making their linen and other necessary household articles, but for the seed, which is all exported.

If the common soil provinces were grouped to show the relative amount of land sown to flax the provinces at the head of the list would be Pskoff and Lifland. More than a tenth of the arable land in these two provinces is devoted to flax, and in some districts it even amounts to 20 per cent. of the whole. There are some districts in the above-named provinces, as well as in those of Tver, Vladimir, Smolensk, and others, where all the spring fields are sown to flax. In the provinces of Jaroslaw, Kovno, Vitebsk, Vladimir, and Kostronia, the provinces of Tver, Vologda, Smolensk, Viatka, Olenets, St. Petersburg, Niji-Novgorod, and Courland, the amount of flax cultivated is only six deciatines in a hundred and in some of the neighboring provinces, two

deciatines, while in the provinces of Eastland, Grodno, and Archangel one deciatine to the hundred is sown to flax.

The picture, however, presents itself somewhat differently if we examine the figures of flax cultivation. In this case it appears that this cultivation is concentrated principally in two regions of the Empire, the first being the eastern region, extending from Upper Volga to Upper Kama, embracing the provinces of Tver, Jaroslaw, Vladimir, Kostroma, Vologda, Niji-Novgorod, Viatka, and Perm, and including almost the half of all the land devoted to the cultivation of flax in the common soil provinces of the Empire. The center of the other, the western region, is the province of Pskoff. To this region, besides the province of Pskoff, belong also those of Lifland, Vitebsk, Kovno, and Smolensk, and the proportion of flax land in these provinces is 24 per cent. of the entire arable fields. It therefore follows that in the remaining twelve out of the twenty-five common-soil provinces the proportion of land devoted to the cultivation of flax is about 25 per cent., and this is devoted to the cultivation of flax fiber.

In speaking of this industry in Russia, it must also be said that flax is also grown in almost every province of the kingdom of Poland, although in most cases only in quantities sufficient to supply the home demand. In western Siberia the surface of land devoted to the cultivation of flax fiber is also considerable and the product finds a ready sale in St. Petersburg, whence it is exported to European markets. In the district of Turkistan the large proprietors cultivate flax simply for the seed. Flaxseed is also the principal reason for which flax is sown in the Caucasus, although in some places, in the district of Lenkoran, for instance, the dolgounets-flax is sown, and an excellent fiber is produced. Lastly the amount of land sown to flax in Finland is about 13,550 acres. Thus, taking the whole Russian Empire into consideration, it can be said that the cultivation of flax in Russia occupies about 4,150,000 acres.

The data received by the Agricultural Department from proprietors relative to the flax crops for the last 7 years show excessively small figures. So that the flaxseed crop per deciatine (2.7 acres) for the average of 5 years, in the common soil provinces, is about 18 bushels and in the black soil provinces about 16 bushels. The crop of flaxseed is still less in those regions where the principal object of the flax growing is the production of the fiber and therefore flax-dolgounets (high-growing) is sown, which forms comparatively small heads, with seed, and is reaped before its complete maturity, whereas where flax is cultivated with the object obtaining the seeds a crop of 20 to 30 poods of seed per deciatine is considered unsatisfactory.

The average crop of seed for 5 years in the south sandy lands varies from 16 to 21 poods per deciatine. It must be stated, however, that this region during the past years has suffered greatly from drought, a condition that affects flax-growing more seriously than the cereal crops. The principal reason, however, of poor flax crops must be attributed

to the fact that fresh or virgin land is no longer to be found, and that soft natural earth, bearing from year to year the same crop, has lost in a considerable degree its productive qualities.

The tables below show the average crop of seed to the deciatine, the general crop per province, per region, and for the whole Empire, with the exception of Poland; the average local price of seed per pood, and the value of the total produce of flaxseed in Russia. The figures contained in these tables prove that of the total quantity of flaxseed produced in Russia the common soil provinces produce 53 per cent., and the black soil provinces 48 per cent. Besides this, the flaxseed grown in the south is principally oleaginous, and is valued in the interior markets, as well as in those of Europe, somewhat lower in price than seed received in most of the common soil provinces, although the latter is also destined for the mills, but its principal importance is as seed for the next year's crop.

In reality, of $11\frac{1}{4}$ bushels, which is the average crop per 2.7 acres of land in the common soil provinces, 40 per cent. is retained by the proprietors for seed, and the portion which is exported is mostly purchased for seed by German and Belgian proprietors, who reap their own flax before the seed has matured. The local demand for flaxseed as seed is exceedingly large after a rainy summer, and likewise in the north-eastern region when an early autumn sets in. In general, the highest average local prices are given in the provinces of Olenets, Jaroslaw, Kostroma, Vladimir, and Pskoff, which finds its sale of flaxseed secured by all the flax-producing region of common soil provinces; and lastly, the provinces of Courland and Lifland, which also produce flaxseed of high quality, readily sold abroad. Good flaxseed for sowing purposes grown in the province of Pskoff is highly esteemed, and brings from $3.10 to $3.90 per bushel.

Thanks to all the data obtained it is seen that in the average for the period, 1882–1886, in the common soil provinces, 13 copecks more per pood of seed were paid than for the seed of the black soil provinces, and the total cost of seed produced exceeded the production of the black soil provinces by 3,279,158 poods, or more than 21 per cent. This calculation somewhat varies if the quantity of seed kept for the next year's crop is taken into consideration. In the black soil provinces the amount of seed sown on one deciatine of land differs, according to the locality, from 2 to 10 poods, and on an average about 4 poods.

In the common-soil provinces one estimates that from 4 to 10 poods and on an average 7 poods of seed are required per deciatine. Consequently the quantity of seed required in order to sow the whole land devoted to the production of flax is estimated to be 3,620,151 bushels in the common-soil provinces and 1,459,311 bushels in the black-soil provinces; the quantity of seed which therefore remains for sale in the first-named provinces is 6,367,107 bushels, valued $6,388,809, and in the second-named provinces this amount is 7,206,645 bushels, estimated at

$6,445,940; so that all the empire of Russia in Europe disposes of 13,573,753 bushels of flaxseed valued according to the average local prices at $10,557,360, all of which is intended for the oil-mills and for export.

Flax crop and prices.

Provinces.	Flaxseed.					Flax fiber.			
	Land sown to flax.	Average crop per 2.7 acres.	Average crop per province.	Average price per 36 pounds.	Value of total production.	Average yield per 2.7 acres.	Average crop per province.	Average price per 36 pounds.	Total value of production.
Black soil.	*Acres.*	*Pounds.*	*Bushels.*			*Eng.lbs.*	*Tons.*		
Don District	252,691	756	1,313,455	$0.57	$1,154,383				
Ecatherinoslaw	252,728	720	1,203,669	.62	1,170,038				
Kherson	164,389	648	548,287	.67	717,834				
Tauride	117,607	576	448,025	.65	453,003				
Tamboff	103,736	1,188	815,075	.56	716,359				
Saratoff	68,618	1,116	521,232	.52	421,619				
Samara	67,146	1,188	526,793	.48	393,339				
Poltava	57,891	1,080	413,505	.59	382,722				
Varonej	57,342	1,080	409,590	.57	363,170				
Besarabia	44,666	864	255,235	.58	232,263				
Kazan	40,819	900	242,968	.51	190,865				
Orenburg	39,404	864	225,165	.36	126,092				
Riazan	37,309	1,080	266,490	.50	234,343				
Kharkow	35,377	720	173,224	.58	164,634				
Penza	32,543	1,296	278,941	.50	216,954				
Tchernigow	31,258	1,008	208,386	.52	170,182				
Oufa	26,876	1,152	204,768	.42	135,375				
Simberia	22,302	1,080	159,300	.47	116,466				
Volhynia	21,713	1,036	185,845	.57	164,783				
Orel	12,293	1,080	87,808	.65	92,198				
Toula	11,958	828	65,486	.55	56,027				
Astrakhan	10,298	720	49,037	.48	36,996				
Kieff	5,260	1,008	35,064	.56	30,817				
Podolia	3,218	720	15,325	.60	14,304				
Koursk	1,933	1,080	13,809	.61	13,103				
Total	15,516,375	951	8,666,282	0.57	7,767,861				
Common soil.									
Viatka	247,455	612	1,001,604	.57	888,088	468	21 446	$2.09	$2,490,118
Pskoff	220,390	432	629,686	.81	793,405	666	27,182	2.33	3,518,579
Lifland	180,203	504	600,678	.67	621,368	720	24,027	2.08	2,776,453
Kostronia	150,379	432	429.656	.70	467,836	468	13,033	2.50	1,810,132
Vladimir	148,332	792	779,597	,69	836,767	684	18,852	2.17	2,272,713
Koona	136,598	900	813,086	.63	790,500	630	15,937	1.87	1,534,894
Niji-Novgorod	113,686	1,080	812,044	.59	745,276	558	11,748	1.50	918,999
Tver	113,640	720	541,145	.60	505,068	684	14,394	2.05	1,639,315
Yaroslaw	104,895	612	424,575	.71	468,919	540	10,489	2.39	1,391,506
Perm	101,404	576	381,301	.52	312,474	432	7,612	2.13	910,209
Vitebsk	98,747	576	376,174	.62	359,879	594	10,862	1.95	1,176,716
Smolensk	98,188	756	490 941	.64	488,759	720	13,092	1.35	986,900
Vologda	67,041	684	303,281	.67	313,727	612	7,617	2.50	1,057,873
Vilna	58,806	720	280,030	.61	263,538	540	5,880	1.81	591,265
Minsk	52,564	792	275,333	.56	237,704	558	5,431	1.61	485,772
Novgorod	49,559	576	188,794	.65	190,882	684	6,277	2.12	739,291
Mohilieff	44,080	684	199,410	.54	165,954	612	13,991	1.43	1,111,508
Kalouga	40,737	900	242,486	.56	211,232	684	5,160	1.67	378,732
Courland	33,969	756	170,343	.73	192,109	882	5,565	2.07	679,974
Moscow	33,845	864	139,826	.68	203,067	810	5,077	1.60	451,288
St. Petersburg	30,556	540	109,128	.67	112,887	792	4,482	2.25	560,250
Grodno	23,366	828	127,955	.58	114,449	468	2.025	2.75	309,375
Olenets	11,842	720	56,391	1.00	87,720	702	1,539	2.70	230,850
Eastland	7,363	576	28,049	.50	21,816	828	11,173	1.88	1,166,957
Archangel	3,845	576	14,647	.62	14.012	432	307	3,50	42,637
Total	2,171,490	688	9,421,160	9.64	9,407,436	631	10,528	2.05	29,247,286

The above table shows the quantity of flax fiber obtained per deciatine in the common-soil provinces, the average crop per province, the average price per pood of flax, and the value of the total product, calculated on the average of the five-year period 1882–1886.

It is thus seen that the average yield of flax fiber per deciatine or 2.7 acres is about 631 pounds. As to the variations of average crops for separate years, one can form some idea by studying the following: In 1882 the average crop per 2.7 acres amounted to 684 pounds with the proprietors and 612 pounds with the peasants; in 1883 the proprietors received 684 pounds and the peasants 666; in 1884 the proprietors got 630 pounds and the peasants 576; in 1885 the proprietors received 504 pounds and the peasants 486; in 1886 the proprietors received 648 pounds and the peasants 648; in 1887 the proprietors received 684 pounds and the peasants 648 pounds.

FLAX CROP OF OTHER COUNTRIES.

The flax crop of other countries is much higher than in Russia. Thus, according to data given by the Flax Supply Association in Belfast, 1 hectare of land gave the following number of kilograms: In Germany, in 1875, 352 kilograms; in 1879, 410 kilograms; in 1883, 410 kilograms; on an average 391 kilograms per hectare, or 940 pounds per 2.7 acres. In France, in 1876, 698 kilograms; in 1882, 761 kilograms; in 1884, 815 kilograms; or an average of 758 kilograms or 677 pounds per acre. In Austria, in 1878, 430 kilograms; in 1882, 426 kilograms; in 1885, 502 kilograms; or an average of 453 kilograms or 404 pounds per acre. In Hungary, in 1877, 603 kilograms; in 1882, 413 kilograms; in 1885, 375 kilograms; or an average of 464 kilograms or 415 pounds per acre. In Holland, in 1876, 498 kilograms; in1882, 442 kilograms; in 1884, 518 kilograms; or an average of 486 kilograms or 433 pounds per acre. In Belgium, in 1878, 527 kilograms; in 1881, 502 kilograms; in 1884, 503 kilograms; or an average of 511 kilograms or 456 pounds per acre. In Ireland, in 1878, 284 kilograms; in 1881, 470 kilograms; in 1885, 486 kilograms; or an average of 410 kilograms or 329 pounds per acre. In Great Britain, in 1878, 489 kilograms; in 1881, 471 kilograms; in 1885, 470 kilograms; or an average of 477 kilograms or 423 pounds per acre. In Italy, in 1875, 284 kilograms; in 1879–1883, 290 kilograms; or an average of 258 pounds per acre. In Greece, in 1875, 312 kilograms per hectare, or 258 pounds per hectare. In Denmark, in 1878, 314 kilograms; in 1881, 290 kilograms; or an average of 302 kilograms or 270 pounds per acre. In Switzerland, for the five-year period 1881–1885, an average of 2.83 cwts. per tumland, or 227 pounds per acre; so that Switzerland only gives as little flax fiber to the acre as Russia. The production of flax in Denmark, Italy, and Greece is considerably better; in Germany and Ireland the crops are from 50 to 60 per cent. higher than those of Russia; in England, Austria, Hungary, Holland, and Belgium, the crops are from 70 to 100 per cent., and lastly those of France 200 per cent. larger than that of Russia. If we stop to consider why the crop per acre is so small in Russia, it would seem to be from two causes: the climate and consequent condition of the soil seem to be unfavorable, and, secondly, an important reason lies in the fact that the Russians are neither skilled nor economic farmers.

YIELD OF THE COMMON-SOIL PROVINCES.

It is well known that the process of separating the fiber from the stalk and also the further manipulation of the fiber affect not only the quality but also the quantity of the product received.

Owing to the extensive surface devoted to flax cultivation the total quantity obtained in the common-soil provinces amounts to more than 243,000 tons. If indeed we take into consideration that the flax-lands have been increased considerably within the last three or four years and if we recognize the fact that there are many small farmers from whom the central bureau of statistics was not able to get any data, a conservative estimate would show that the common-soil provinces yielded during the past year not less than 275,000 tons of flax proper.

The amount of flax produced in the kingdom of Poland is not less than 1,800 tons. Again, the cultivation of flax for its fiber, with a view to industry, is extending in many places of the black-soil provinces. For instance, in the province of Kazan, in the northern districts of the provinces of Simberia, Reazan, Orloff, and Tchernigow, in Constantinograd, and several districts of Poltava, as well as in the districts of Tcheliabin and Traitsky, in the province of Orenburg, a noticeable increase is found. Lastly, in every black-soil province where flax is cultivated, a certain portion of the fiber is worked, from which the peasants make, for their own use, a coarse tissue for sacks and underlinen known as Russian crash. At the same time there is no official data as to the exact quantity of flax worked in the provinces of the black-soil region, but without doubt this quantity must amount to at least 50,000 tons.

In Finland, according to official data obtained in 1885, 138 tons of flax fiber was obtained in the province of Newland; the province of Äbo gave 315 tons; Tavastguss gave 740 tons; the province of Viborg gave 264 tons; the province of St. Michel gave 152 tons; those of Kouopia, 101 tons; Vasa, 156, and Ouleaborg, 2 tons, making a total of about 1,600 tons. Thus the total amount of flax fiber produced yearly in Russia in Europe may be said to amount to about 350,000 tons, amounting to 360,000 tons in good years and to 270,000 tons in bad years. In the year 1881 it is known that 270,000 tons of flax fiber were exported abroad.

THE WORLD'S FLAX PRODUCTION.

In comparing the cultivation and production of flax fiber, Russia far surpasses all other countries. Neiman Spallart gives the countries of Western Europe, with the amount of land sown to flax and their respective crops. (See Uebersichten der Weltwerthschaft, Yahrgang 1883–'84, p. 386.)

Country.	Year.	Acres.	Tons.
Germany	1883	267, 534	48, 753
Austria	1885	210, 834	47, 209
France	1884	110, 635	38, 101
Ireland	1885	107, 940	23, 366
Belgium	1884	99, 014	22, 134
Italy	1883	169, 287	21, 306
Holland	1884	26, 082	6, 001
Hungary	1885	27, 089	4, 501
Switzerland	1884	27, 664	2, 851
Denmark	1881	4, 754	613
England	1885	2, 487	519
Greece	1875	958	133
Total	.....	1, 053, 678	215, 496

Considering that in Roumania, Servia, Bulgaria, Turkey in Europe, Spain, and Portugal, of which no data are given, the production of flax amounts to about 4,500 tons, still the total produced in Europe does not exceed 225,000 tons, whereas Russia alone produces about 330,000 tons per annum.

As the yearly production of flax in the United States of America only amounts to about 45,000 tons and the production of all the remaining countries is equivalent to that produced in the Siberian colonies, it follows that Russia produces fully 25 per cent. more flax than all the rest of the world combined.

LOCAL PRICES IN RUSSIA.

The local prices of flax depend upon the quality of the flax rather than upon the quantity. Thus, according to the data received from the correspondents of the department, the average price per pood or 36 English pounds in 1882 was $1.83; in 1883, $1.85; in 1884, $1.93; in 1885, $2.05; in 1886, $2.03; in 1887, $1.96. If we consider the local autumn price paid for flax in the provinces grouped together, we find that in the black-soil provinces the average for 1882–'86 was about $1.50 for 36 English pounds, while in the provinces of Oufa and Orenburg the price was $2.25. In the common-soil provinces the lowest price was about $1.75 in the western provinces; in the industrial provinces this price rose to 1.85, in the Baltic provinces to $2.07 (that is to say, about equal to the prices paid in the central and transvolga provinces), and to $2.25 in the northwestern provinces. If proprietary flax be taken separately, the difference in prices is excessive; in some places the prices fell 50 cents and in other cases they rose to $5 and $6 per 36 pounds; and also in the provinces taken separately the variations of prices were quite remarkable. From the foregoing tables it is seen that in the provinces of Smolensk and Mohilieff the average price for five years did not exceed $1.50, whereas in the provinces of Kostroma, Vologda, Archangel, Olenets, and Grodno the price rose to $2.50 and higher.

In the provinces which produce the most flax fiber, namely, the provinces of Viatka and Lifland, the pood costs about $2.10 and in the province of Pskoff about $2.33.

Because of the difference in prices, the value of the total production according to provinces does not agree with the distribution of the latter according to the quantity produced, leaving out of the question the amount of land sown. For instance, the province of Viatka, which has the largest acreage devoted to the cultivation of flax, occupies, according to the value of the fiber produced, only the third place, giving precedence to the provinces of Pskoff and Lifland. The total value of fiber produced in the common-soil provinces exceeds $30,000,000, and, if to this amount is added the amount of fiber produced in the black soil provinces and the annexed provinces, the total value of the production of flax fiber throughout Russia in Europe amounts to $36,000,000. I have already shown above that the value of the flaxseed produced amounted to $17,175,297; therefore the total gross revenue obtained from the Russian flax industry amounts to about $53,000,000.

FLAX CULTIVATION.

It is difficult to learn the net profit of the flax industry, having at present only the above data, but there is no doubt that it, in many places of the common soil provinces, is one of the most profitable of the country, especially if carefully managed.

If the proprietors are robbed and the manipulation of the fiber passes into bad hands the result will be, as is too often the case, that the proprietor is bankrupt. The instances are great in number and are met with in all the provinces devoted to the culture of flax. Prince Vassiltchikoff says that to his knowledge certain proprietors and villages have been completely ruined by the cultivation of flax, through unbusinesslike methods, such in fact that result in a few years in rendering the soil absolutely worthless. In the flax-producing districts of the province of Pskoff the rental of land for flax is called "a sale;" "to rent" and "to sell" in those places are synonymous terms, and the prices for renting land, as has been mentioned above, often equal the selling prices. In fact after a crop of flax, if the land is not properly manured or is not allowed to rest a year or two from flax cultivation, it loses all its producing qualities and becomes worthless. Therefore the peasants of the province of Pskoff have been observed to emigrate from the northwestern flax-producing districts to the southeastern districts, where there still exists plenty of virgin soil.

But it is well known that there are means of conducting a regular series of flax crops without injury to the land. If a peasant has means sufficient he knows how to improve his lands by the use of artificial and vegetable fertilizers, which he uses to his profit. But even the poor peasant understands that he must practice the system of crop rotation, or his little farm will soon be ruined. Experience proves that flax uses up the land, at least for the purposes of flax-growing, so rapidly that the same field can not be flax-sown oftener than every 6 or 7 years without irreparable injury to the soil.

The Russian cultivators of flax sow very different crops upon their flax fields to keep their lands from deteriorating; but the most successful seems to be that of alternating their fields with wheat, clover, and other species of grass for fodder. It has been already proved that unless the flax fields can be rotated with pasture-land fields for the raising of cattle and horses, or with a series of successive clover crops, the flax lands soon become unproductive. Therefore an economic school of farming is coming into general favor in many of the provinces, which combines with great success stock-farming with flax-raising.

According to data obtained in 1883 by the flax committee attached to the Imperial Voluntary Economic Society the cost of production of flax per deciatine is as follows:

Provinces.	Average cost of—		
	Production.	Preparing fiber.	Total.
Minsk, Vitebsk, Vilna	$7.30	$10.50	$17.90
Pskoff	7.80	10.85	17.60
Novgorod, Tver, Smolensk, Kalouga	9.35	9.00	18.35
Vladimir, Yaroslan, Vladimir	8.60	12.20	20.80
Vologda, Viatka	6.85	8.50	15.35
Average	7.80	10.20	18.00

The above figures are incredibly low, and can only be explained by the fact that the peasants receive a mere pittance for a day's labor. To speak in comparative figures with reference to the wages of the workmen of other countries, the expense of working a deciatine in flax would not cost less than $20.

PROFIT OF FLAX-GROWING.

From 1 deciatine of land sowed to flax the farmer derives in the common soil provinces about 15 bushels of seed and about 610 pounds of flax fiber. Setting aside 4½ bushels of seed for the next year's sowing, there will remain 10½ bushels of linseed, or an income from the seed alone amounting to more than $9 per deciatine. The flax proper, 610 pounds, would average about $36, so that the total product would be about $45 per deciatine. The average expense for cultivating this amount of flax land is about $20 and the rental of the land is fairly estimated at $7.50; therefore one would have a net profit of $17.50 per deciatine. This is certainly a very good revenue even for the proprietor who has to hire all of his labor, and still better for the peasants who do their own work.

HOUSE INDUSTRY VERSUS FACTORY.

At the beginning of this report it was said that the ancient inhabitants of Novgorod conducted a large flax business, not only with the neighboring principalities, but with the Hanse towns of the Baltic. Besides the amount exported there existed at that epoch a sale of flax

fiber in such places of the interior districts in which it was not produced at all or was produced in insufficient quantity. Similar movements of flax exist also to-day, but with this difference, that to-day the export of flax abroad has taken immense proportions, consuming one-half of the total production.

It must also be said that the means and character of the home trade has greatly changed. Every family prepared from its own crude flax linen and cordage necessary for its domestic use. Later on small industrials presented themselves in some places, working either for others according to order, or making different flaxen articles for sale, for which they generally purchased their flax elsewhere than at home. In this manner there were opened more or less important centers for the home consumption of flax fiber. In time linen mills were introduced into Russia, forming already a more solid center for the sale of flax goods than could be depended upon with the "Koustar" trade.

Not entering into details, it must still be said that the total amount of crash or linen made by the peasants, prepared for sale, amounts to 117,000,000 yards. According to data taken from the collection of "military statistical collection" the province of Viatka is at the head of the Koustar linen and crash industry, and prepares about 18,000,000 archines or 14,000,000 yards per annum; then come—

	Yards.		Yards.
Yaroslaw	12,500,000	Kostroma	4,670,000
Tver	8,560,000	Koursk	3,890,000
Vologda	7,800,000	Orel	2,730,000
Perm	5,840,000	Tamboff	2,400,000
Kalouga	5,500,000		

In the western region the extension of the flax industry has increased, but the sale of the Koustar flax products has for some time decreased, and for the last few years is decreasing to such an extent that all the surplus fiber is sent in its crude state to points whence it can be exported. For instance, in some places of the province of Lifland, the peasants not long ago occupied themselves with the manufacture of linen and crash, and sold their work not only in the villages and towns of that province but in St. Petersburg, Moscow, and other towns in central Russia. The rapidly advancing manufactories have obliged the Koustars almost to abandon their industry. In the same manner the Koustars in the above-named provinces of the northeastern region are beginning to abandon their industry, forced to compete with large flax mills.

The first spinning mill in Russia was erected in the sixteenth century, when the English had opened a trading-way through the White Sea. The English opened a rope mill and flax-spinning mill at Kholmogar.

Peter the Great undertook a number of means to develop the number of linen factories in Russia, and his imperial successors did the same. According to statistical information of the last century the number of mills in existence were:

In 1761, 54 mills, producing $320,753; in 1765, 60 mills, producing $451,435; and in 1776, 70 mills. The beginning of the present century has been marked by wars which could not do otherwise than influence not only the Russian export of raw material, but also the manufacture and the exportation of manufactured goods; and notwithstanding this, in 1809 the Russian production of linen was represented as follows:

Provinces.	Mills.	Looms.	Production.	Mills exporting.	Exportation.
			Yards.		*Yards.*
Vladimir	110	7,818	8,078,155	16	8,599,150
Kostroma	24	4,341	3,587,888	11	2,794,532
Kalouga	20	2,283	1,628,433	12	1,122,839
Moscow	19	968	890,854	?	69,417
Yaroslaw	13	2,302	1,633,528	?	251,222
Smolensk	7	528	253,509	1	38,888
Tver	5	168	229,444	.....	.....
Toula	2	228	157,017	2	134,128
Mohilieff	5	97	56,683	1	31,265

However, the hesitancy of Russian manufacturers to adopt improved machinery, the increase of cotton mills and their produce, and the success of flax factories abroad, place most of the mills in Russia in an embarrassed position from a lessening demand and consequent fall in prices, and gradually decreased their number until the result was as follows: In 1820, there were 214 mills in Russia; in 1830, there were 190 mills; in 1835, there were 171; in 1863, there were 109 mills, producing to the value only of $4,025,000.

In the recent years there is again an increase, both in the number of mills and in their productions. The following table will show this reaction for 1880–'84:

Years.	Russia in Europe.			Poland.		
	Mills.	Value of product.	Laborers.	Mills.	Value of product.	Laborers.
1880	158	$12,402,500	24,631	15	$1,348,500	9,339
1881	153	11,869,000	33,688	14	1,138,000	7,298
1882	154	12,022,000	32,170	18	1,528,000	7,425
1883	160	13,565,000	35,991	21	1,920,000	8,402
1884	166	13,173,500	38,966	19	1,871,500	7,810

The yearly product of flax mills and flax-beating works of Russia in Europe in 1884, is as follows: Twelve factories produced less than $1,000; 61 produced from $1,000 to $5,000; 18 produced from $5,000 to $12,500; 14 produced from $12,500 to $25,000; 15 produced from $25,000 to $50,000; 26 produced from $50,000 to $250,000; 14 produced from $250,000 to $500,000; and 6 produced from $500,000 to $1,000,000.

The value of the production of one mill alone in the Kingdom of Poland exceeded $1,500,000. Out of the 166 mills and factories in the provinces of Russia in Europe, 55 occupied themselves with cleaning the flax by breaking and hatcheling; 24 with the preparation of yarn, 87 with the manufacture of linen.

The table below shows the division of these three classes of factories:

Provinces.	No. of works.	Production.	Value.	Laborers employed
		Tons.		
Pskomir	40	12,114	$1,483,500	1,209
Vladimir	8	1,710	213,500	486
Olonets	3	171	19,000	173
Tver	2	774	67,500	212
Viatka	1	468	50,000	470
Poltava	1	72	10,000	155

As seen, of the 324,000 or 342,000 tons of flax which are produced yearly within the limits of Russia in Europe, the flax mills only consume about 18,000 tons. This table, however, can not be said to be exact, as the statistics obtained from the province of Viatka show that in the district of Vélij the flax produced by the peasants is mostly bought up in its crude state and worked by the inhabitants of that province. During the winter some 300 or 500 peasants of the district of Tchepel are employed each day cleaning the flax. The district of Vélij prepared and exported about 18,000 tons of flax during the winter 1886–'87.

Some of the spinning mills have textile departments attached to them, with a total of 1,160 looms, on which 242,000 pieces of linen and duck, and 480,000 sacks or bags are manufactured, for a value of $1,097,000. Thus the real annual product in the 24 factories, shown below, amounts to $7,636,000.

Flax-spinning Mills.

Provinces.	Number of mills.	Quantity of yarn produced.	Value.	Laborers employed.	Number of spindles.
		Tons.			
Vladimir	8	7,380	$2,007,500	6,374	51,200
Kostroma	6	7,110	2,053,500	6,390	63,000
Yaroslaw	4	5,462	1,672,000	4,518	40,000
Riazan	1	1,278	253,000	715	7,600
Karan	1	450	187,500	1,000	12,700
Vologda	1	432	175,000	1,304	3,784
Liefland	1	396	125,000	335	4,000
Courland	1	126	60,000	117	2,000
Nize-Novgorod	1	27	5,500	27	500
Total	24	22,661	6,539,000	20,780	184,784

Linen Factories.

Provinces.	Number of miles.	Pieces of linen produced.	Value.	Workmen employed.	Number of looms.
Vladimir	32	452,000	$1,867,500	7,105	2,521
Kostroma	24	327,300	1,080,000	5,329	2,800
Moscow	10	16,800	101,000	636	421
Tchernigow	10	5,300	18,500	164	90
Yaroslaw	4	60,000	245,000	261	300
St. Petersburg	2	125,200	490,000	1,421	253
Tamboff	2	7,400	9,500	43	42
Novgorod	1	40,000	100,000	425	72
Kalouga	1	1,500	16,500	87	20
Tver	1	500	2,000	10	10
Total	87	1,036,000	3,930,000	15,481	6,529

Besides these, different textile works prepare 300,000 pieces of linen on 1,160 looms, for a value of $1,097,000, so that the total amount of linen manufactured amounts to over $5,000,000. It appears that the

flax mills are mostly concentrated in that group of provinces called the industrial provinces. In these provinces the number of purchasers for flax mills is greater than in other parts of the Empire, so that the peasants, having profitable work, do not trouble themselves with the preparation of linen and crash even for their own use. Besides this, these provinces raise a large quantity of cereals under the plan of crop-rotation mentioned above, and are one of the principal centers where flour is made, so that the demand for flour bags, as well as for sail-cloth for the river boats, is more important than in any other part within the limits of Russia in Europe. Many trials to revive the flax industry in the western flax-producing provinces have proved futile, principally because of the meager demand for manufactured articles and because of the comparatively easy sale of crude flax for export.

PREPARING THE FIBER.

For this reason, in the western region there exist no really favorable conditions for the preparation of flax-fiber and its separation from the stalk. As has been said, the flax industry in Russia is mostly in the hands of the peasants, who pay too little attention to the method of manipulating it and obtaining from the stalk a clean, well prepared, and assorted stalk for the markets.

The best known method in Russia for separating the fiber from the stalk is the rotting process. The method of moistening the flax is little practiced in most of the places of the eastern flax-producing region, whereas it is still less known and scarcely ever practiced in the southern and western regions, although this method gives a much better flax than that obtained by the process of exposing it to the dew and rain.

When the flax has been exposed, the operation of separating the fiber from the stalk takes from 4 to 5 and even 6 weeks' time, whereas when it has been macerated in summer it only requires from 8 to 10 days.

The color of macerated flax is always more even than that of littered flax; the latter, even in the best conditions, receives different tints, such as light with gray or brown.

The fiber of macerated flax is uniformly strong throughout its whole length, when properly handled, which can not be said of flax exposed to the dew; and in general, macerated flax fiber is stronger than that obtained by the former process, in consequence of which, in working the flax with machinery, separating the good, from 25 to 30 per cent. less yarn is obtained from the flax exposed to the dew than from the macerated flax. This fact very greatly raises the price of the latter compared with that of the former. The yarn obtained from the latter is much rounder and more even than that of the first, in which are often met flat fibers and bits of dried stems.

With the maceration system the chances of a good manipulation of the fiber are much greater than when the flax is exposed to the dew. If the flax which has been grown on a well-known soil is macerated in water, whose quality is known, the proprietor may be certain that he

will receive a uniformly good quality of fiber in a definite number of days; whereas when the proprietor exposes the flax to the weather he is liable to serious consequences, which may occur as well from the excessive rainfalls of autumn as from continued drought, frost, and cold winds, not allowing the flax thus exposed to lie until the time when it could be properly handled, although in a clear and warm autumn, with occasional rain and great dew-fall, the fiber may receive a high quality; but such autumns are very rare.

The obstacle which places itself in the way for changing the method from exposing to the dew to that of maceration is the want of water suitable for the maceration process. And, in reality, every kind of water is not suitable for this purpose. Flax can not be macerated in hard water containing either iron, lime, or salt, nor are stagnant waters, containing slime, clay, sand, and like substances, which injure the color and quality of the flax, to be used for this newer and better process. And, likewise, every field is not suitable for the spreading out of the macerated flax, the worst being reddish clay, red sandy ground, and places covered with slimy and red stagnant water. Some of the best places for maceration are on turf ground and moss ground, as likewise in marshy places of white and blue clay. A very good ground also for maceration is the black soil and sandy soil. In general it is easier to find a ground suitable for maceration than is generally thought, if it be accepted that the maceration should not take place in streams and lakes because of the danger in hygienic relations.

The principal obstacle which prevents the maceration of flax from being extended, is the ignorance of the best means to accomplish it. And even in these provinces, where maceration of flax has long since become the rule, it generally gives dissatisfaction, in consequence of which fact the splendid quality of Russian flax is spoiled even there, after great precautions were taken for its cultivation.

Before being worked, the stalks of the macerated flax, as well as that which has been exposed to the dew, are dried in ovens, and it often occurs that these heated rooms are made too hot or filled with smoke, in which event the filament becomes darker or loses its oleaginous matter and becomes hard and brittle. The working of the flax takes place, in most cases, in the most primitive manner, with simple hand-brakes, which generally injures the too ripe stalks, besides the fact that the most practiced hands can only work about 72 pounds of flax a day. More improved brakes are only to be found in the western provinces, in that of Pskoff and some of the neighboring districts, where some proprietors have installed brakes run by horse-power. Lastly, the final step in the working of the flax, the scutching, takes place in a similar and most primitive manner, for which they use the ordinary wooden scutcher, in the shape of a long, narrow knife or oar.

Scutching by machinery is employed as a rarity, exclusively here and there in the provinces of Lifland, Pskoff, and Vladimir. It may be stated, however, that scutching by machinery only presents an ad-

vantage if the flax has already been sorted according to the length, thickness, and maturity of the stalk. Different qualities of flax can not well be scutched at one time by machinery, because it would become thicker and stick faster in one part than in another, and therefore the the obstructed bollen in the filament would become uneven. If scutched by hand, the laborer can direct his blows where he sees it is necessary, whereas machinery scutches everywhere evenly and it can therefore happen that all the bollen in one place will necessitate such long-continued working that at the same time nearly all the residue becomes ruined. And at the same time it must be remarked that flax is rarely assorted by the Russian farmer.

In general, the manipulation of the flax in Russia is so primitive and poor that, as a result, the price offered for it abroad is much lower than that paid for German, Austrian, Irish, and especially French and Belgian flax. When flax is purchased as it is when it enters the market, the manufacturer can not know what he is purchasing, that is to day, he does not know how much clean flax he will have nor the quality. It is, therefore, easy to understand that the purchaser wishes to guaranty himself against such loss and therefore purchases at very low prices, a fact that causes the Russian farmers to lose needlessly about $15,000,000 a year.

The Agricultural Department urged the Government to take this question up and to use all means to teach the peasants how to work the flax. It reasoned that in Germany and Austria teachers had been called for by the government, and that here the same might be done, or at least to organize model farms on the principle of those in vogue in Finland, for the cultivation of flax, or to install stations in the provinces, where the manipulation of flax could be done by experienced hands, such as the one which has already been organized by Mr. Herman Getze, 9 miles from the town of Viaznikoff, in the province of Vladimir. It is said that the filament obtained by Mr. Getze is most perfect, and therefore his flax sells at $3.50 to $4, and the higher quality from $4.50 to $5 per 36 English pounds, against $1.50 and $2.50 paid for local flax worked by the peasants. Again, Mr. Getze obtains 32 Russian pounds of pure filament and 8 pounds of tow from 5 poods of crude flax, whereas the peasants obtain only 33 pounds of filament from 7½ to 8 poods of crude flax and no tow whatever. Besides these facts Mr. Getze's establishment has proved the great advantages that could be reaped from such stations.

The flax committee of the province of Pskoff has taken up this question and has decided upon the Lefebure system, but it can in no way be compared to the system organized by Mr. Getze.

FLAX-SORTING.

As has been stated above, the Russian farmers in no way embarrass themselves by sorting the flax, but mix all together, thin, thick, long, short, good, and poor. In this shape it is purchased by small dealers

and finally reaches the warehouses of rich merchants, where it is assorted according to its quality. It is generally best assorted in ports whence it is expected to reach foreign markets, and it therefore takes foreign marks or names which are almost historical on account of their long standing.

In Archangel and the localities trading in flax, it used to take the name of the locality from which it came, but, as all kind of swindling was discovered, since 1838, flax in Archangel has been purchased under three sorts named "assorted," kron (crown), and brak or waste. Flax tow is divided into two grades, the first sort being subdivided into three sorts and the second quality into two other sorts.

At St. Petersburg the flax is arranged for export into three sorts, the first of which is according to the number of handfuls, generally contains twelve, and forms a twelve-headed bale; the second is composed of nine heads, and the third sort is composed of a six-headed bale.

In the towns of Rjev and Viaznia, and other centers of foreign export, the flax is in a crude state and forms four sorts, second, third, fourth, and fifth grades, the first quality being assorted, but there is very little of this grade.

In Riga, according to the rules fixed by the exchange committee in 1872, there are 33 sorts, which are divided into 4 divisions: The kron or crown, brak or waste, dreiband or third sort, and dreiband waste or fourth sort. Each of these sorts has received a special mark and name, and at the same time the price in the exchange report is applied to the kron sort only, which is considered as the base for fixing prices. As the price of kron flax has remained the same for the last four years the table given below shows the difference in the prices as they really are.

	Mark.	Price for 10 poods or 360 pounds.
A. Kron or first quality.		
Kron	K.	$22.50
Kron hell (light crown)	H. K.	23.00
Kron weiss (white crown)	W. K.	24.00
Kron grau (grey crown)	G. K.	24.00
Puik kron (picked crown)	P. K.	24.00
Puik kron hell (light)	H. P. K.	24.50
Puik kron weiss (white)	W. P. K.	25.50
Puik kron grau (grey)	G. P. K.	25.50
Superior puik kron	S. P. K.	26.00
Superior puik kron hell	H. S. P. K.	26.50
Superior puik kron weiss	W. S. P. K.	27.50
Superior puik kron grau	G. S. P. K.	27.50
Spanisch weiss kron (Spanish)	S. W. K.	30.50
B. Second quality.		
Wrack (waste)	W.	19.50
Puik wrack	P. W.	21.00
Puik wrack weiss	W. P. W.	21.00
Puik wrack grau	G. P. W.	21.00
Hofs dreiband (superior third quality)	H. D.	21.00
B. Second quality.—Cont'd.		
Hofs dreiband weiss	W. H. D.	$22.50
Puik hofs dreiband	P. H. D.	22.50
Puik hofs dreiband weiss	W. P. H. D.	24.00
Fein puik hofs dreiband	F. P. H. D.	24.00
Fein puik hofs dreiband weiss	W. F. P. H. D.	25.50
Superior fein puik hofs dreiband	S. F. P. H. D.	25.50
Superior fein puik hofs dreiband weiss	W. S. F. P. H. D.	27.00
C. Third quality.		
Dreiband	D.	17.00
Puik dreiband	P. D.	18.00
Livland dreiband	L. D.	17.50
Puik Livland (lifland)	P. L. D.	18.00
Slanitz dreiband (exposed to dew)	S. D.	17.00
Puik Livland dreiband	P. S. D.	18.00
E. Fourth quality.		
Dreiband wrack	D. W.	16.00
Slanitz dreiband wrack	S. D. W.	15.00

Besides the Spanish crown flax, formerly flax was classified in Riga according to nations in which the flax was grown—Belgian crown, French crown, or English crown—the highest quality being the English crown; but with the increased export to Germany, which reëxported the greatest portion of this flax to other European countries, the assortment of Riga flax under classification of different European countries lost all importance.

The marks adopted by the province of Pskoff are those known by the name of Pskoff-Narva brands. The crown quality is divided into four sorts, namely: R., Risten, or very highest; H. D., Hofs Dreiband, high quality; D., Dreiband, ordinary; O. D., Ordinärer Dreiband, ordinary, third sort.

The wrack or waste is not specified, but the above crown marks are subdivided into G, or gray; W., or white; although the difference in color does not alter the price. The letters F and P express the quality of the fiber, F., or fine, and oleaginous; P., strong and heavy; thus, W. F. P. R. signifies white, fine, strong, highest quality.

PRICES OF FLAX.

The large number of different sorts of flax occasion also a very varied list of prices, besides the variations upon the crops and the demand. Thus in St. Petersburg the prices paid for the different sorts varied per berkovets or 360 pounds in 1884 from $8.50 to $31.50; in 1885 from $8.50 to $32; in 1886 from $9 to $34; in 1887 from $13.50 to $32.

The variations for the average yearly prices during the years 1883 to 1887 are as follows:

Varieties of flax.	1887.	1886.	1885.	1884.	1883.	Average.
Macerated.						
Pskoff assorted	$26.84	$31.84	$27.15	$22.50	$21.00	$25.87
Pskoft ordinary	25.78	28.06	23.79	20.25	19.00	23.38
Louga	23.53	25.85	21.31	18.00	17.25	21.19
Solets, first sort	21.40	23.28	18.88	15.75	15.25	18.91
Solets, second sort	19.65	18.93	15.20	13.75	13.75	16.26
Solets, third sort	14.40	13.39	10.14	10.25	11.00	11.83
Exposed to the dew.						
Yaroslaw	28.65	31.12	29.68	28.00	25.75	28.54
Kootroma	29.60	31.71	30.38	29.50	26.00	29.44
Biejeto	26.40	29.65	25.95	23.25	21.00	25.25
Kachinsk	26.67	28.32	26.00	23.25	20.25	24.90
Volegda	29.65	33.07	30.84	29.75	28.25	30.31
Ouglits	25.75	30.12	26.49	24.50	21.75	25.72
Phominsk	25.50	24.33	24.31	23.75	21.75	23.93
Exposed to dew and worked.						
Melenkow	25.25	25.61	24.54	23.50	22.00	24.63
Rjew	24.50	27.69	26.17	23.50	21.50	24.18

If we separate the different kinds according to their prices it appears that, although in general the difference of the average for the five-year period for different sorts is not the same, it happens that the price of

one grade rises while that of another falls. Thus, for instance, for 1886 to 1887, most of the grades declined more or less in price, whereas, at the same time, Solets macerated flax of the second and third grades and Phominsk exposed flax somewhat rose in price. This fact is also observed in other markets where flax is not classified according to the name of the place where it is grown, but according to its quality, such as in Riga. This fact is due not to the crop, but to the bad assortment. This is the principal cause of complaint received from foreign purchasers, who, when ordering a special mark or brand and not knowing before hand whether or not it will correspond with that of the same mark received the previous year, therefore pay a lower price for it, in order to protect against loss. In Melenk, the pood of flax of an average quality sold from 1885–1887 as follows: In 1885, from $1.25 to $2.13; in 1886, from $1.50 to $2.37; in 1887, from $1.75 to $2.25. The higher quality as follows: In 1885, from $2.25 to $2.80; in 1886, from $2 to $3; in 1887, from $2.25 to $2.87.

In the village of Grodets the price of a high-quality flax varied, in 1887, from $2.50 to $3.13 per pood. In Riga a berkovets or 360 pounds of flax was quoted in the market as follows: 1886, K., or crown flax, from $20 to $24.50; 1887, K., or crown flax, from $20 to $22.50; 1886, H. D., or superior Dreiband, from $19 to $22.50; 1887, H. D., or superior Dreiband, from $18 to $21.

In Warsaw macerated flax brought, per pood: In 1886, from $2.40 to $3.80; in 1887, from $2.40 to $3.15; and dew-exposed flax, per pood, brought: In 1886, from $1.60 to $3; in 1887, from $2 to $3.

In general the variations in the prices of different assorted flax fiber are very great, and as said before depend less on the place where it was grown than in the manner in which it is manipulated and assorted. It is a well-known fact that the best flax produced, when it has not been properly exposed to the dew or macerated or has been badly dried and manipulated, renders the lowest grade of fiber. The peasants' flax mostly reaches the market in its crude state, not having been manipulated. Besides this there is a great complaint of their adding to the flax, thus made up in bundles, sand and other heavy substances of no value.

A very important question is that of the variation of prices of flax for a long period; unfortunately the material on this subject is very scarce and in many instances false, as it is not always known whether the prices refer to high or low grades. But nevertheless it is known that up to the years in 70 of the present century the prices of flax fiber, as well as of other agricultural products, have more or less gradually risen.

Thus in the half of the sixteenth century, 360 pounds of flax in Novgorod cost up to $1.50 and in the town of Kholmogar it cost $2. At the beginning of the seventeenth century, flax in Kholmogar was sold at the rate of $4 for 90 pounds. Considering the quantity of flax ex-

ported and its price, the average for 360 pounds of flax was about as follows:

1749	$10.50	1824–'26	$20.50
1758–'60	11.50	1833–'35	17.50
1778–'80	15.00	1842–'44	14.50
1790–'92	14.00	1845–'47	16.00
1802–'04	19.00	1848–'50	12.00
1814–'15	17.50	1851–'53	14.00
1820–'21	21.50		

These figures, in general, are proved by the following data relative to the average prices in St. Petersburg and Riga, the two principal points of Russian flax export, namely:

Period.	St. Petersburg.	Riga.
1832–'41	$16.78	$15.18
1833–'42	16.50	15.00
1834–'43	16.20	14.50
1835–'44	15.50	14.15
1836–'45	15.30	13.90

According to the price current, as published by the customs department of the ministry of finance, the prices for the exports of flax from Archangel, St. Petersburg, and Riga, from 1855 to 1886, were, per 360 pounds, as follows:

Years.	Archangel.		St. Petersburg.		Riga.	
1852	$13.00 to	$23.00	$10.78 to	$16.00	$9.00 to	$20.00
1853	14.00	24.00	10.78	18.58	11.00	17.50
1854	12.00	21.75	.....	.....	8.50	16.00
1855	9.75	14.75	.....	.....	9.50	15.00
1856	14.50	19.00	11.43	15.00	10.50	15.75
1857	16.25	22.38	11.43	17.85	10.50	17.00
1858	16.50	23.65	12.00	22.50	9.00	28.50
1859	17.50	30.00	13.00	27.50	10.00	32.00
1860	21.00	30.00	15.50	24.00	9.50	26.50
1861	20.88	29.00	13.00	22.50	11.00	26.00
1862	20.00	26.13	13.50	26.00	15.00	26.00
1863	21.00	31.00	11.50	23.50	16.50	26.50
1864	22.50	33.50	11.50	19.00	15.00	31.00
1865	22.50	36.75	11.50	19.00	16.50	32.92
1866	29.50	50.00	11.50	33.50	16.50	38.50
1867	20.50	41.00	11.50	30.00	.....	
1868	20.00	37.50	11.50	25.00	12.00	34.50
1869	22.50	39.50	17.00	32.50	13.00	30.65
1870	20.00	36.50	12.50	32.50	13.00	30.65
1871	21.50	40.00	12.50	22.00	13.00	28.50
1872	25.86	31.67	12.50	20.00	16.26	27.31
1873	21.84	31.67	12.50	23.88	15.38	26.93
1874	23.50	29.88	12.50	26.50	17.97	25.65
1875	19.00	36.25	12.50	26.50	12.00	32.00
1876	20.25	38.00	12.50	26.50	20.00	32.00
1877	21.60	40.50	13.00	36.50	15.00	34.00
1878	24.00	39.25	10.50	36.50	16.00	30.00
1879	26.00	39.50	10.50	34.00	15.00	30.50
1880	25.25	37.75	12.00	34.00	.....	
1881	19.00	32.00	12.00	30.00	.....	
1882	22.50	29.50	29.92	27.50	11.00	32.50
1883	21.25	31.25	9.50	29.75	11.50	28.00
1884	20.75	32.25	8.62	31.50	16.50	29.00
1885	22.25	35.75	8.50	32.00	17.50	30.00
1886	23.50	33.50	9.00	34.00	19.00	29.50

The Agricultural Department somewhat criticises some of the above stated prices, and as an instance it says that from 1864 to 1865 the highest price obtained in St. Petersburg, according to all belief, was higher than $19; the lowest price for flax exported from Riga in 1886 being $19. But this price was lower for H. B. and not for D. W., which to all belief was also exported from Riga.

The average prices for periods of 5 years of 360 pounds of flax exported were as follows:

Years.	Archangel.	St. Petersburg.	Riga.	Average.
1852–'56	$16.58	$13.74	$13.28	$14.53
1857–'61	22.72	17.93	18.00	19.55
1862–'66	29.28	18.05	23.39	23.59
1867–'71	29.90	20.70	21.83	24.14
1872–'76	28.26	18.99	22.55	23.27
1877–'81	30.43	22.90	23.42	25.58
1882–'86	27.25	20.08	22.45	23.26

The movement of prices in the markets abroad more or less corresponded with the movement of prices in Russia. Thus in Hamburg, per 100 kilograms of flax, there were paid as follows:

	Marks.	Pfennigs.
In 1847–'50	94	80
In 1871–'75	123	12
In 1885	148	20
In 1886	132	34

Comparative prices of flax in Ireland for 36 years, as published by Villars Stewart in Dublin and London, 1887, are shown below:

	s.		s.		s.		s.
1850	40	to	70	1870	44	to	76
1851	40		60	1871	64		112
1852			40	1872	60		70
1853			46	1873			66⅔
1854			46	1874	56		76
1860	42		91	1880	50		80
1861	36		72	1881	24		84
1862	56		84	1882	32		80
1863	60		88	1883	36		76
1864	44		84	1884	44		76

If these weights and currency are converted into currency of the United States, 360 pounds of Irish flax for the average of 1880–1884 cost about $51.60, and for 360 pounds of Hamburg flax in 1885 about $60.74; in 1886 about $60.27. As I have already said, French, Holland, and Belgian flax commands still higher and is sold at $70 per 360 pounds. Russian flax, on account of the bad manipulation, is generally sold 50 per cent. less than that of Belgium or France.

According to the Report of the Flax Supply Association in Ireland for the year 1887, the average prices in the London market, for flax of different countries, is as follows, per 360 pounds:

Countries.	1883.	1884.	1885.	1886.
Belgian	$72.58	$71.60	$60.97	$49.85
Dutch	60.00	62.90	59.03	59.53
French	55.16	46.45	38.71	50.32
Irish	52.26	54.19	48.38	44.52
German	30.00	30.97	35.80	34.84
Prussian	30.00	30.97	34.84	33.87

PRICES OF FLAX SEED.

I have already given the average price of flaxseed for the five-year period 1882–1886 at the place of production, and I have shown that, according to the quantity and quality of the crop, the price ranges from 25 and 30 cents to $1.50 and $2 per 36 pounds, going as high as from $2.50 to $3 for the best seed raised in the province of Pskoff, and that of the northeastern flax-producing provinces, whence it is purchased for seed, the difference in local prices does not appear so great, if the average prices grouped by provinces of the common and black soil are taken. According to information obtained from proprietors the prices for six bushels of flaxseed in the black-soil provinces ranged as follows:

In 1883	$5.25	In 1886	$5.11
1884	5.11	1887	4.98
1885	5.74		

The average price was $5.24 per six bushels.

In the common-soil provinces flaxseed sold as follows:

In 1883	$10.24	In 1886	$5.12
1884	5.95	1887	4.78
1885	6.75		

The average for this five-year period was $5.57 for six bushels. As is seen from the above, the differences in the prices, if the different years are considered, is much greater than if the groups of provinces are considered. This is explained by the fact that nearly the whole of the seed produced by the proprietors in both the black-soil provinces and the common-soil provinces of Russia goes to the oil mills, and for this purpose the seed produced in some places, for instance in the province of Borisogliebsk, is more suitable than the seed produced in most of the common-soil provinces, where the flax has been pulled before the plant has fully matured; consequently, the seed obtained in the south gets a higher price than that grown in the common-soil provinces and exported from the Baltic ports and Archangel. For instance, for the five-year period 1882–1886 for six bushels of seed one paid on an average, in Odessa, $7.88, and, in Taganrog, $7. 10, whereas in St. Petersburg only $6.71, in Riga $6.53, and in Archangel $6.19, although some of the qualities brought to the ports obtained higher prices than the best

goods in the southern ports. In the south the different sorts are classified according to the amount of dirt the seed contains, usually from 10 to 15 per cent., whereas the seed in the northern markets is classified, besides that containing dirt, into oleaginous and seed for sowing, the latter being the more expensive, also according to the places where it is grown, a matter of considerable importance in the ports of the Black Sea.

As I have already stated the variations in the prices differ from year to year. This variation depends upon the crops in the other countries of Europe as well as upon the condition of the universal markets. Below I give the tables showing the prices quoted by the exchange in Archangel, St. Petersburg, Riga, Odessa, and Taganrog, from 1852 to 1886, per six bushels.

Years.	Archangel.	St. Petersburg.	Riga.	Odessa.	Taganrog.	Average.
1852	$3.00 to $3.83	$2.85 to $4.00	$3.00 to $4.30	$3.12 to $3.90	$3.00 to $3.50	$3.40
1853	3.02 3.78	3.00 4.07	3.00 4.30	2.95 3.62	2.27 3.27	3.27
1854	3.12 3.75	3.00 3.75	2.25 3.75	3.07 4.72	1.50 3.85	3.22
1855	2.30 2.57	2.00 3.00	2.92 4.50	.....	.....	2.87
1856	2.75 4.12	3.00 5.50	3.00 5.80	4.37 6.32	3.50 6.00	4.43
1857	4.00 5.40	3.50 6.25	5.17	4.87 6.37	4.75 6.50	5.20
1858	4.30 5.00	4.25 5.50	3.50 6.00	4.40 5.75	4.00 5.90	4.87
1859	4.37 4.50	4.25 5.00	2.50 4.87	3.50 5.00	3.75 4.75	4.25
1860	3.50 4.50	3.50 5.50	3.25 5.00	3.50 5.25	4.25 5.00	4.32
1861	4.20 4.90	5.00 6.50	4.75 6.57	4.17 5.90	4.50 6.00	5.25
1862	4.75 6.00	5.00 6.62	.....	4.05 6.50	4.00 7.00	5.49
1863	5.65 6.25	3.50 6.62	2.87 5.75	5.25 6.50	4.50 6.75	5.37
1864	4.35 6.00	3.72 6.50	.....	5.00 6.50	4.50 7.00	5.44
1865	4.60 6.12	4.56 6.50	5.20 6.00	5.25 6.32	5.50 6.50	6.15
1866	5.90 7.37	5.00 6.50	4.00 6.37	6.00 7.87	5.95 7.50	6.25
1867	5.00 6.45	5.87 6.75	4.00 6.87	6.37 7.37	5.25 7.00	6.10
1868	5.30 6.30	6.37 6.75	3.50 5.50	6.12 6.75	4.87 6.62	5.77
1869	6.12 6.92	6.37 6.87	4.05 5.15	5.50 7.00	5.00 7.50	5.90
1870	5.50 6.45	6.50 7.25	3.62 5.00	5.87 7.25	5.00 7.62	6.12
1871	5.75 6.32	6.25 7.10	4.55 5.62	6.00 7.00	5.25 7.25	6.10
1872	5.67 5.95	6.70 7.33	4.64 4.99	6.13 6.82	6.20 7.19	6.20
1873	5.50 5.67	6.75 7.50	4.29 4.70	6.17 6.55	6.17 6.82	6.05
1874	5.50 5.67	5.81 6.67	4.32 4.60	5.75 6.07	5.89 6.14	5.65
1875	4.90 5.37	5.62 6.50	3.40 4.81	5.62 6.00	5.25 6.62	5.40
1876	4.25 5.50	6.12 6.50	4.12 5.12	5.65 6.12	5.50 6.62	5.55
1877	5.00 7.00	6.50 9.12	3.95 7.00	6.50 7.00	5.50 6.62	6.42
1878	5.35 7.00	5.12 8.75	5.12 7.00	6.75 8.00	6.25 8.00	6.75
1879	6.45 7.15	5.62 8.12	4.37 7.25	8.40 9.00	7.25 9.00	7,20
1880	6.75 6.93	5.62 8.87	5.00 7.50	8.06 9.50	8.12 9.00	7.60
1881	6.50 6.50	6.00 8.37	.....	6.07 7.87	6.75 8.50	7.02
1882	6.13	5.12 7.25	5.04 7.50	6.25 7.37	7.00 8.00	6.62
1883	6.33 7.00	5.87 7.12	5.52 5.90	7.02 8.50	6.00 6.32	6.60
1884	6.00	6.25 7.25	8.00 8.75	7.75 8.50	6.25 6.90	7.32
1885	.....	5.55 8.75	5.10 8.90	7.75 8.75	6.25 8.12	7.40
1886	5.62 6.00	5.25 8.75	7.00 8.60	7.65 8.75	7.00 7.75	7.23

The information given in this table, which has mostly been obtained from the Report upon the Interior Commerce of Russia, is defective in that the information as to the prices of seed as well as of flax fiber is not complete. It often happens that in some years the data given do not relate to all the grades. With this in view the average yearly export prices of all the five markets must be considered as being approximate. The table below, showing the average yearly prices of seed per six bushels for periods of five years from 1852 to 1886, may be considered as more exact.

Five-year periods.	Archangel.	St. Petersburg.	Riga.	Odessa.	Taganrog.	Average.
1852–1856	$3.22	$3.41	$3.67	$4.01	$3.36	$3.54
1857–1861	4.47	4.92	4.62	4.87	4.94	4.76
1862–1866	5.70	5.45	5.01	5.92	5.92	5.60
1867–1871	5.48	6.51	4.77	6.75	6.13	5.95
1872–1876	5.47	6.55	4.49	6.09	6.24	5.77
1877–1881	6.46	7.15	5.27	7.71	7.50	6.84
1882–1886	6.18	6.71	6.53	7.88	7.10	6.88
Averages	5.28	5.83	4.91	6.17	5.88	5.62

Thus it is seen that the price of flaxseed has increased each period of 5 years, having attained in 1877–1886 nearly double that which it had in the first five-year period. In 1872–1876, however, there was a slight fall in the price of the seed as well as in the fiber. The reason why in the five-year period 1882–1886 higher figures were obtained than in the five-year period 1877–1881 is explained principally by the want of exact data from the Riga market. Formerly in this market the price of flaxseed was not quoted for a tchetvert, or six bushels, but for a barrel, which contains two thirds of a tchetvert, or four bushels; the figures shown for the period of 1882–1886 refer without doubt to tchetverts. Therefore the prices of the Riga market, of all the remaining years, are surely calculated one-third lower than they should be; therefore the high rise during the five-year periods 1877–1881 and 1882–1886 is erroneous.

If we add to the above figures the prices of flaxseed for the period 1827–1851 we obtain the following table of the movement of approximate prices per bushel for 60 years:

1827–1831	$0.50	1857–1861	.79
1832–1836	.66	1862–1866	.93
1837–1841	.63	1867–1871	.99
1842–1846	.58	1872–1876	.95
1847–1851	.56	1877–1881	1.14
1852–1856	.60	1882–1886	1.15

Thus, the movement of price of flaxseed ran on a parallel with the price of flax fiber; the prices fell from 1830 to 1855 and rose rapidly after the Crimean war and later after the freedom was given to the serfs. The difficulty of sale and the fall in price in the market, which have affected most of the agricultural products within the last few years, have scarcely affected the flax industry. The most sensitive fall in price of flaxseed as well as of flax fiber was in the year 1887. In that year a bushel of flaxseed brought in St. Petersburg from 79 cents to $1.19, and on an average $1.07 against $1.13 in 1882–1886; in Odessa, from 12 to 14 cents, or on an average 13 cents per 36 pounds against 14 cents in the five-year period which preceded; in Taganrog, from 10 to 13 cents, on an average 11½ cents per 36 pounds against 12 cents. In Riga, however, the price of a pood of flaxseed in 1882–1886 was 10½ cents, and in 1887 the price was from 10 to 13 cents, on an average 12 cents.

EXPORT OF FLAX PRODUCTS.

Among the flax products exported, the principal are flax fiber, tow, and different flax manufactures. The following table shows the proportion and gradual increase of export of flax products as it is given for the period from 1749 to 1887.

Years.	Flax.		Tow.		Years.	Flax.		Tow.	
	Quantity.	Value.	Quantity.	Value.		Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*			*Tons.*		*Tons.*	
1749.....	9,029	$555,500	1,117	$20,500	1866.....	86,310	9,591,088	14,364	977,674
1758–1760.	9,861	622,500	332	5,500	1867.....	89,244	.....	9,792	.....
1778–1780.	10,291	902,500	483	8,500	1868.....	130,644	14,515,054	16,848	1,146,814
1790–1792.	20,082	1,567,500	508	16,000	1869.....	107,532	16,428,568	19,206	1,334,082
1802–1804.	23,212	2,597,500	1,137	(*)	1870.....	196,876	28,548,984	20,358	1,413,698
1814–1815.	19,798	2,226,500	839	33,000	1871.....	163,890	23,791,384	16,740	1,162,206
1820–1821.	29,282	3,553,500	1,524	59,000	1872.....	130,302	18,957,197	13,968	1,404,201
1824–1826.	38,942	4,488,500	1,626	62,500	1873.....	162,738	20,376,891	10,498	881,093
1833–1835.	33,325	3,239,500	5,997	296,000	1874.....	179,820	24,147,927	12,456	1,020,347
1842–1844	62,441	4,656,500	8,293	325,500	1875.....	170,118	23,140,803	11,520	1,026,498
1845–1847.	45,279	4,075,500	12,127	568,500	1876.....	122,796	16,420,746	9,918	1,354,061
1848–1850.	76,337	5,092,000	10,230	419,000	1877.....	201,780	31,589,978	11,142	1,720,397
1851–1853.	67,354	5,262,500	13,218	529,500	1878.....	175,320	28,259,708	9,000	1,688,593
1854–1856.	43,701	.....	9,155	.....	1879.....	202,608	34,834,536	23,076	2,221,357
1857.....	32.980	7,567,025	17,010	727,293	1880.....	172,656	27,785,039	27,558	2,627,243
1858.....	69,861	6,825,332	11,574	543,270	1881.....	233,086	34,891,503	33,408	3,454,576
1859.....	59,784	6,603,870	19,828	1,184,755	1882.....	218,894	32,742,254	27,108	2,726,727
1860.....	71,370	7,791,405	10,062	552,972	1883.....	197,442	28,422,849	26,784	2,701,716
1861.....	61,560	6,788,099	15,087	921,312	1884.....	200,052	29,364,021	30,024	3,037,750
1862.....	75,569	8,241,998	14,616	891,592	1885.....	168,372	23,108,624	34,812	2,943,668
1863.....	75,636	8,271,665	14,166	966,370	1886.....	127,998	19,304,799	27,216	2,262,062
1864.....	76,320	7,942,518	14,598	1,118,989	1887.....	153,918	23,797,500	45,138	2,721,000
1865.....	116,784	12,975,016	14,040	960.066					

* Included in the flax.

As can be seen the export of flax according to its quantity and price varies greatly. For instance, from 1830 to 1840, from 1850 to 1855, in 1874–1877, and also in the last three years the export of flax visibly decreased, but in general the Russian participation in the supply of the western Europe mills with raw material increased rapidly only for the period 1861 to 1881, in quantity only four times, and in price more than five times. The decrease of flax for the last years must be regarded as temporary. The reason can be explained in that the high prices paid for cereals in the first part of the last ten years caused many of the proprietors to abandon the cultivation of flax for that of cereals. The amount of flax exported in 1887 already proves a return to the former output. With regard to flax-tow it must also be said that its export has also increased, but in a much smaller proportion than that of flax proper. Lastly, the value of flax fiber and its manufactures can be seen in the following table:

Years.	Flax yarn.	Sail cloth.	Flemish linen.	Ravens-duck.	Toweling.	Crash.	Table linen.
1860	$7,500	127,500,000	$14,400,000	$53,900,000	$5,000	$256,850,000	$20,150,000
1865	11,250,000	51,350,000	26,900,000	59,700,000	12,450,000	613,000,000	50,900,000
1870	957,500,000	147,300,000	1,400,000	22,200,000	....	232,750,000	151.700,000
1875	123,300,000	56,300,000	25,000	14,500,000	800,000	136,600,000	45,250,000
1880.....	47,600,000	82,152,000	200,000	9,600,000	.....	304,350,000	128,550,000
1885	80,300,000	54,800,000	1,450,000	13,850,000	3,150,000	221,550,000	(†)

Therefore the exports of flax products have not increased, but have decreased, forming for the last years not more than one-fifth of the value of manufactures of the same kind imported from abroad.

The table below shows from what ports or frontiers of Russia the flax fiber has been exported during the five-year period 1857–1861 compared with the years 1885, 1886, and 1887.

Description.	1857–1861.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
White Sea:				
Flax	5,776	4,938	2,426	1,656
Tow	5,147	3,269	1,708	936
Baltic Sea:				
Flax	60,164	90,854	70,265	92,808
Tow	7,836	24,478	19,469	22,878
Black Sea:				
Flax	1	.....	3,316	.....
Tow	0	.....	.....	.....
Western land frontiers:				
Flax	3,197	72,440	51,422	59,454
Tow	1,337	6,658	5,885	9,324

Thus it is seen that the exports from the Baltic Sea, and especially by the land frontiers, have greatly increased; by the White Sea the export has decreased, and in the Black Sea it is only occasional. A small quantity of flax is exported to Finland and by the Asiatic frontier. In 1886, 334 tons of flax and 459 tons of tow were sent to Finland, and 221 tons of flax and about 1 ton of tow were exported by the Asiatic frontier.

The following table shows the amounts of flax exported abroad from 1884 to 1886 and through what custom-houses it passed:

Custom-houses.	1884.	1885.	1886.	Average.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Verjbalow	65,899	18,884	35,978	50,250
Riga	53,068	50,517	35,583	46,330
Pernau	18,152	16,313	8,287	14,251
St. Petersburg	14,177	14,393	11,747	13,439
Reval	12,521	7,164	8,389	9,491
Graeff	11,587	7,771	4,158	7,839
Sosnovitz	5,940	7,755	6,053	6,583
Archangel	4,808	4,938	2,430	4,059
Libau	838	2,466	5,716	3,053
Kretingensen	2,812	2,645	1,068	2,175
Gorjdow	2,449	1,978	1,708	2,045
Granitsa	2,403	2,168	1,408	1,993
Oissian	991	473	528	662
Alexandrow	261	576	47	295
Vladislavow	105	93	142	113
Taoweogen	154	23	55	77
Yourburg	77	13	36	42

In 1887, the export from Riga amounted to 49,176 tons. From Verjbalow, 36,144 tons; from Reval, 21,888 tons; from Graeva, 12,114 tons; from St. Petersburg 8730 tons; from Sosnovitz, 5,184 tons; and from Libau, 2,356 tons.

The following table shows to what countries Russian flax is principally exported; it being understood that much of the exports to England are really destined to the United States:

Exported to—	1884.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Germany	89,434	65,458	48,665	61,938
England	55,383	57,582	36,503	56,658
France	32,906	21,700	20,392	20,754
Austria-Hungary	8,600	10,095	3,457	1,926
Holland	1,699	279	3,410	.....
Belgium	9,016	10,880	10,489	12,636

The countries to which tow is most largely exported and the respective amounts are shown in the following table:

Exported to—	1884.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
England	11,907	17,208	15,372	17,550
Germany	7,041	9,076	7,080	11,268
France	5,045	3,193	960	1,179
Belgium	3,113	2,213	1,764	?
Holland	1,406	559	302	?
Denmark	126	1,177	773	?

So it is seen that most of Russian flax fiber is exported to Germany whereas the greatest purchaser of Russian tow is England. Formerly both the flax fiber and tow went principally to England, so that in the ten year period from 1857 to 1866, from the total quantity, there was exported:

To—	Flax.	Tow.
	Per cent.	*Per cent.*
England	71	78
Germany	7	13
France	6	1
Holland and Belgium	5	3
Norway and Sweden	1	1
Denmark	1	0

Consequently the flourishing manufactories of England required three-fourths of the flax tow exported from Russia, whereas the German manufacturers demanded very little. But from the year 1870, Germany has rapidly increased its manufactures of flax goods and is to-day the first on the list.

As has already been stated above, Russia supplies almost all the countries with flax. Of the total amount of flax imported into Germany, Russian flax represented 87.1 to 94.2 per cent. from 1880 to 1884, about 88.6 per cent. in 1885, and about 85.4 per cent. in 1886.

The percentage of Russian flax imported into England, compared with the total import of flax into England, was, for 1886, 63 per cent.,

and for 1887, 74 per cent. And these percentages are almost the same in the other countries of Europe. Generally speaking, notwithstanding the great competition brought to flax by cotton, it may be stated that the Russian flax industry has nothing to fear whatever in this industry, which will still flourish, especially if proper means are employed to improve its manipulation.

The export of flaxseed, like that of flax fiber has also increased, although it may be said that these two products have nothing to do one with the other; as for instance in the southern provinces no account of the fiber is taken, whereas in the northern region the crop of flax fiber may be abundant and that of flaxseed nothing.

There is no exact information relative to the export of flaxseed up to 1827, because up to that period flaxseed was not classified separately in the report of interior commerce. From 1827 to 1887 the average amounts of flaxseed exported per periods of 5 years were as follows:

Period.	Quantities.	Period.	Quantities.
	Bushels.		*Bushels.*
1827–'31	3, 620, 184	1862–'66	8, 588, 682
1832–'36	3, 333, 482	1867–'71	14, 159, 442
1837–'41	5, 567, 484	1872–'76	14, 653, 080
1842–'46	6, 672, 918	1877–'81	14, 655, 162
1847–'51	7, 537, 938	1882–'86	10, 451, 172
1852–'56	8, 343, 936	1887	13, 146, 000
1857–'61	8, 688, 984		

As is seen, the gradual increase of foreign export continued until the eighties. In 1882 a larger amount of flaxseed was exported than had been exported for many years, while in 1885 it was quite insignificant and only amounted to 3,940,490 bushels. In 1886 the exports appeared somewhat improved, and in 1887 it again attained the figure which is only a little less than for the 5-year period, 1877–'81. The following table, however, will better demonstrate the variations in the exports of the flaxseed:

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Tons.			*Tons.*	
1870	366, 422	$13, 571, 190	1879	480, 557	$20, 538, 206
1871	388, 030	14, 371, 506	1880	402, 570	18, 638, 681
1872	364, 517	11, 146, 773	1881	383, 505	16, 138, 723
1873	393, 655	13, 858, 444	1882	470, 772	18, 623, 698
1874	461, 869	15, 883, 831	1883	364, 715	14, 965, 206
1875	413, 630	14, 348, 227	1884	270, 560	10, 749, 221
1876	344, 492	11, 902, 369	1885	109, 093	4, 332, 650
1877	266, 900	11, 361, 032	1886	183, 767	7, 362, 433
1878	435, 813	17, 959, 686	1887	354, 960	13, 435, 500

The division of the amount of flaxseed exported from Russia, passing through the different custom-houses of Russia, is as follows:

Frontiers.	1884.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
White Sea	10,347	176	954	6,796
Baltic Sea	112,561	66,229	99,023	236,668
Russo-German	22,205	13,898	20,067	21,240
Russo-Austrian	11,602	1,043	1,418	
Russo-Roumanian	.....	1	156	
Black Sea	35,649	6,193	27,810	103,266
Azof Sea	87,638	21,554	34,349	
Finland	9	191	212	(?)
Asiatic	741	495	2,243	(?)

The principal ports through which the flaxseed passes going abroad are Riga, Libau, St. Petersburg, Revel, Rostoff, Odessa, and Nicolaieff, and the principal land frontiers are the Warsaw frontier and those of Verybaloff and Sosnovitz.

The amounts of flaxseed exported from Russia during the last 4 years were directed to the following countries:

Countries.	1884.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
England	164,557	53,500	86,639	199,602
Germany	32,509	22,067	29,681	41,400
Holland	27,406	13,142	32,897	45,432
Belgium	16,517	12,039	25,488	38,106
France	10,725	2,990	3,161	4,496
Denmark	7,418	891	3,321	(?)

Besides flaxseed, flax oil and residue are exported, but as the latter are not specially classified in the "report of the interior commerce," but are condensed with the same products obtained from hempseed and sunflower seed, the figures below must be considered as much above the reality:

Year.	Flaxseed oil.		Flaxseed residue.	
	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*	
1870	37	$4,162	12,045	$334,588
1871	100	11,106	12,776	354,963
1872	327	44,499	16,462	439,750
1873	222	26,779	15,368	408,599
1874	974	101,465	17,454	421,366
1875	222	24,635	19,857	409,581
1876	330	40,646	27,748	698,825
1877	140	20,344	25,566	659,771
1878	305	60,493	26,961	656,312
1879	139	17,050	30,043	748,843
1880	548	70,514	30,507	880,542
1881	35	4,099	30,895	911,006
1882	156	25,161	48,825	1,439,428
1883	.....	.....	74,602	2,239,980
1884	.....	.....	196,166	2,483,845
1885	120	16,454	102,301	2,474,967
1886	103	14,707	86,583	1,921,921
1887	29	3,500	97,812	2,074,509

As is seen, the exports of flaxseed varies very greatly from year to year, whereas the export of residue not only increases, but seems to have a progressive increase. The largest amount of residue exported is directed to England, and next in order to Germany, Denmark, Belgium, Switzerland, and France.

If the value of all the flax products be added together, it appears that the average for the last few years amounts to about $45,000,000. In 1856–'60 this amount was only about $14,500,000; in 1861–'65, it was $17,000,000; in 1866–'70 it was $29,000,000; in 1871–'75 it was $39,000,000 and in 1876–'80 it was $46,000,000. Therefore flax and its products amount to about one-sixth of all the goods exported from Russia, showing conclusively that the flax industry merits full attention, not only as an object of revenue for the proprietors, but also as one of the principal national industries of the empire.

J. M. CRAWFORD,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
St. Petersburg, February 10, 1891.

FLAX CULTURE IN RUSSIA.

REPORT BY CONSUL HEENAN, OF ODESSA.

Flax is cultivated in all parts of European Russia for local consumption, but it has an importance for manufacture only in twenty-three governments, which sow more than 3,105,000 acres in flax, the remaining twenty-seven governments showing less than 675,000 acres. With regard to the object for which flax is sown European Russia can be divided into two regions—the northern and the southern. In the first flax is sown chiefly to obtain the fiber, although with the fiber seed is also obtained; and in the second nearly exclusively for the seed. The northern region of the cultivation of flax for manufacturing purposes extends from the southeastern part of the Baltic Sea to the central part of the Ural Mountains, within which are the governments of Livonia, Kovno, Vilna (Vitebsk, Pskov, Smolensk, Tver, Yaroslav, Vladimir, Nizhnee-Novgorod, Kostroma, Vologda, Viatka, and Perm. More flax is cultivated in the governments of Viatka and Pskov than in the others. In the first about 251,000 acres are sown into flax, and in the second about 221,000 acres. These two provinces may be considered as the centers of the cultivation of flax, around which the other flax-producing provinces are grouped. The yield of flax per acre in these provinces is very different, and depends on the quality of the soil in which the flax is sown. An acre of good land gives 400 pounds or more of fiber and from 400 to 535 pounds of seed, but an acre of poor, exhausted soil will not yield more than 160 to 200 pounds of fiber and about 265 pounds of seed. The average yield for the entire region may

be considered to be from 265 to 330 pounds of flax fiber and 400 pounds of flaxseed per acre.

The southern region of the cultivation of flax for the sake of the seed consists of the following territory and governments: The Don-Cossack territory, sowing 262,000 acres; Yekaterinoslav government, sowing 251,000 acres; Kherson government, sowing 175,000 acres; Taurida (Crimea), Samara, Saratov, Voronezh, Tambov, and Poltava. In the last two provinces flax is grow both for the seed and fiber. Flax for the seed is mostly sown either in virgin soil or in old fallow lands. The yield of seed in this region varies from 400 to 670 pounds and more per acre, and for an average may be estimated to be about 535 pounds per acre. The total harvest of flaxseed for all of European Russia attains to about 1,800,000,000 pounds. Considering the average value of the flax fiber to be $186 per ton and that of the seed to be $44.10 per ton, it will be seen that value or gain to Russia from the cultivation of flax is about $112,000,000 annually.

The advantages derived from the cultivation of flax would be far more if the qualities of the Russian fiber would correspond with its quantities and if a larger portion of it were to be exported in a manufactured state. As regards its quality, Russian flax is not only surpassed by Irish flax, but also by the flax of many other countries of western Europe (Belgian, Dutch, French, and Bohemian), and is valued in foreign markets lower than any other flax. The low qualities of the Russian fiber are not the result of natural causes, but of the ignorance as to the proper method of treating the flax. The cultivators of flax are chiefly peasants, who partly do not know and partly do not possess the means to acquire the latest improvements in the primary technical manipulation of the fiber. Another cause of the imperfect working out of the flax is to be found in the absence of a home demand for a high quality of fiber. Russian factories do not produce linen from the finest numbers of spun thread, and therefore do not require the highest class of flax. This latter circumstance is unfortunate, as it is a strong impediment to improvements in the manipulation of the flax fiber.

The aim of the producer is a large quantity rather than an improved quality, and the result is a progressive reduction in the qualities of the fiber. Of late years this has become particularly apparent in the government of Pskov. Formerly Pskov flax had a high reputation all over Russia, but now it is quoted much lower than flax from Velogda, Kostroma, Yaroslav, and Tver. About one-half of the flax fiber produced in Russia is exported abroad only half worked (the unbrushed fiber together with the tow), and the greater part of the fiber remaining in the empire is worked up by the peasants in their farmhouses into thread and linen for their own use, as well as for sale. A much smaller part of the flax goes to the spinning and weaving factories, which are chiefly situated in the governments of Vladimeer, Kostroma, and Yaroslav.

As regards the internal or home trade of flax, it is almost entirely in the hands of small dealers, who drive from village to village and make their purchases in small lots. The flax thus collected is then sent in considerable quantities to the towns which serve as centers to the flax trade. In the western part of the northern region the most important centers of the flax trade are Poneviezh (government of Kovno), Düna-burg (government of Vitebsk), Pskov, Ostrov, Opochka, and the hamlet of Soltsy (government of Pskov). From Poneviezh and Düinaburg the flax is chiefly forwarded to Riga, and only a small quantity of it to Libau, and from Soltsy by rafts on the spring high water to St. Petersburg. The port of St. Petersburg receives the flax, tow, and linseed from Tver, Yaroslav, Kostroma, Vladimeer, and even from Vologda and Viatka. In the government of Tver the chief markets for the products of flax cultivation are Byetsk, Rzhev, and Kashin; in the government of Yaroslav, Ooglitch, Rostoff, and the village of Velikoje; in the government of Kostroma, Kostroma, Nerekhta, Kineshma, and Ples; in the government of Vladimeer, Melenki. From the three last-named governments only a small part of the flax is sent to St. Petersburg, the greater part being used up by the flax-spinning and linen-weaving factories. From the governments of Vologda and Viatka the bulk of the flax is forwarded to Archangel. The points where flax produce is collected for shipment by way of Archangel are: In the government of Vologda, Oostioog Velikee; in the government of Viatka, Viatka, Orlof, Slobodskoi, Kotelnik, Glazov, and Kukarka.

In the southern region the chief product of the cultivation of flax (linseed) goes direct by rail to the ports of Odessa, Rostoff, and Taganrog for exportation abroad. As regards the southeastern provinces of Samara, Saratov, and part of Tambov, they send their linseed by the water ways of the Volga and her system of canals to St. Petersburg.

The *Linum usitatissimum vulgare* and *crepitans* are being cultivated in Russia in several varieties of both kinds, but the difference in these varieties is so slight and they so easily blend that even those initiated in the trade of the article often fail to perceive it. Both (*vulgare* and *crepitans*) have blue blossoms and occasionally white blossoms. The blue-blossom varieties are preferred. About 21,000,000 bushels of seed are annually raised in European Russia. The quantity exported was as follows:

	Bushels.
1887	13,000,000
1888	14,000,000
1889	13,500,000
1890 (estimated)	12,000,000

Of the total export of Russian oilseeds England receives (via Hull and London) 57 per cent.; Germany, about 14 per cent.; Holland, about 11 per cent.; and Belgium about 8 per cent. The most important markets for the sale of Russian flax fiber are Dundee, in Scotland; Lille, in France; Ghent and Antwerp, in Belgium.

Flaxseed, as understood in Russia, comprises sowing seed and crushing seed. The first named is a more carefully sorted quality, exported exclusively for sowing purposes. Crushing seed is the surplus seed of the flax plant, which is exported for making oil, etc., as there is no demand for it as sowing seed. With this quality the seed received from the interior is mixed and the whole exported as crushing seed. Of the total quantity exported, viz, 13,000,000 bushels, about two-thirds is described as sowing seed.

The seed is sown in April, May, and early in June. It is sown earlier in the south and southeast than in the center, west, and north; much depends whether the seasons are early or late. The harvest begins as early as July and as late as the months of August and September, earlier in the south and later in the north. The number of bushels of flaxseed raised per acre depends on the object to be attained; when the seed is the object a much less quantity is sown, per acre, and when the fiber is desired a much larger quantity is sown. In the south and east of Russia a little over a half bushel per acre is sown, and the yield is about 10 bushels. In those parts of central Russia where the fiber is not utilized a little over four-fifths of a bushel is sown, and the yield is about 10 bushels. In western Russia and those parts of central Russia where the fiber is utilized, 1 to 1½ bushels per acre are sown, and about 5 bushels is the yield. In northern Russia, where the fiber is the chief consideration, nearly 3 bushels per acre are sown, which gives about 6 bushels of seed and from 300 pounds to 600 pounds of fiber. This year's crop is above the average in quality, but less in quantity than any year since 1885. The seed is ready for export in the months of September, October, and November in the south, and from northern and central Russia often not before March of the following year.

Flaxseed is exported from Riga, Libau, Pernau, St. Petersburg, Rostoff-on-Don, Odessa, Nicoliæv, Sevastopol, Mariopol, Taganrog, Berdiansk, and other ports by water, and also in large quantities by rail to Germany and Austria. Flaxseed is usually sown by hand, and the land should be carefully prepared and be of good quality. The plowing should not be less than 9 inches in depth, and the land should be as free as possible from weeds and thoroughly prepared beforehand for the reception of the seed; after the sowing, the seed is covered by passing a harrow once or twice over the ground. Moist and mild weather favors the development of the plant in all of its parts; a hot and dry climate, with occasional showers, will produce a good development of the seed, but the fiber is usually coarse and brittle, as the lignin parts of the stems then develop at the expense of the fiber. The cultivation of flax, whether for seed or fiber, requires for its proper development a rich black loam (10 to 14 inches) having a clay subsoil; good crops, however, are grown where the subsoil is gravel or gray sand. Flax is grown in nearly every province of European Russia.

The working up of the flax fiber is carried out by the so-called flax-

breaking or flax-swinging, and further by flax-spinning and linen-weaving, factories. The total number of flax-swinging factories is 59; of flax-spinning factories, 20; of linen-weaving factories, 88. These factories produce annually goods valued at $20,000,000 and over, which are made entirely from the flax fiber. Much linen and thread is made yearly by the peasantry at their homes, the value of which can not be obtained. About $5,000,000 worth of linseed oil is manufactured and consumed annually in Russia, a very small quantity being exported. Oil cake, the product of flaxseed, is exported to the value of about $2,500,000 yearly. The lesson to American farmers, especially those of the Northwest, which the total product of the cultivation of flax in Russia furnishes will be readily appreciated and understood. The possibilities which the cultivation of the flax fiber offers to Western farmers is only equaled by the surprise that such possibilities have thus far been neglected, if, indeed, they were not altogether unknown. The seed has been cultivated with more or less satisfactory results in the United States, but the fiber practically not at all. The climate, soil, and conditions generally throughout the Northwest are very favorable to the cultivation of the flax fiber as well as the seed. After a short experience, as to the primary manipulation or handling of the flax fiber, our farmers would produce flax which would compare favorably with the best varieties of the fiber. It seems strange that a practical people like ourselves should for years have been satisfied to cultivate flax for the seed at a value of about $15 per acre, and at the same time we allow 600 pounds of flax fiber per acre to rot on the ground, this flax fiber having a value, after being manipulated, of $186 per ton.

Familiar as our farmers are with the working of improved and expensive agricultural machinery and the latest developments of the human intellect as applied to the soil, they may always learn something by watching the working of rude ideas as seen in a primitive and unsophisticated people. The main difference between the old and the new system of farming is not one of method, but of expense; and, as physicians never really know what a disease is capable of until they see an outbreak in virgin soil, so it is not possible to fathom all the possibilities of the most commonplace notions and devices until we see them applied with the unconventional freedom and simple directness that belong to comparatively primitive peoples. The Russian peasant is both simple-minded and ignorant; he clings to old methods as much from liking as for the expense which new methods involve. From the flax fiber, by the aid of his primitive and rude contrivance, the Russian peasant produces linen, thread, crash, and other valuable and necessary articles for the use of his family and for sale. It does not require the aid of expensive machinery to make the flax fiber either useful or valuable. The rude machines which the Russian peasant employs are the handiwork of some village carpenter or wheelwright, and are made at a comparatively small cost. If the Russian peasant farmer

accomplishes such results, the American farmers, who possess like conditions of climate and soil, should accomplish much more. The unsatisfactory condition of the farmers in our Northwestern States, which is certainly due to the overcultivation of wheat, with its yearly decreasing yield per acre, renders it all the more important that a speedy means be found to relieve a condition of things which affects the material interest and welfare of the great majority of the people of the United States. Such a means exists in the flax plant. It will not only enable farmers to make their own linen, rope, thread, crash toweling, oil cake, and much besides, but will cause new industries to be established throughout the country in districts where the advent would be both profitable und new. There should be a general and persistent effort made to encourage the cultivation of the flax fiber throughout the United States, with the view of establishing factories for the manufacture of twine or textiles, and, if this report should develop a proper interest in so important a subject, the result can not fail to be satisfactory.

FLAX PRODUCT OF EUROPE.

In no country of the world does the cultivation of flax attain such large dimensions as in Russia. Russia alone produces more flax than all the other countries of Europe combined. Exact statistical data regarding the annually obtained products from the cultivation of flax are not compiled either in western Europe or in Russia. There are only approximate valuations, based upon the knowledge of the area which is occnpied under the cultivation of flax and of the average yield per acre. Out of the total area sown in Europe with flax, and amounting to about 5,700,000 acres, more than 3,700,000 acres are sown in Russia. Notice must at the same time be taken of the fact that, while in all European countries without exception the area of land under the cultivation of flax is being annually more and more reduced, it is in Russia, on the contrary, being increased. The total quantity of flax fiber produced in the whole of Europe is estimated to be 1,354,000,000 pounds, distributed as follows:

Countries.	Quantity.	Countries.	Quantity.
	Pounds.		*Pounds.*
Russia	900, 000, 000	Ireland	46, 800, 000
Austria-Hungary	104, 400, 000	Belgium	43, 200, 000
Germany	97, 200, 000	Italy	43, 200, 000
France	79, 200, 000	All other countries	36, 000, 000

Thus the share which Russia has in the total quantity of flax fiber produced in all Europe is exactly two-thirds.

THOS. E. HEENAN,
Consul.

UNITED STATES CONSULATE,
Odessa, January 17, 1891.

DECLINE OF THE IRISH FLAX INDUSTRY.

REPORT BY COMMERCIAL AGENT SMYTH, OF HUDDERSFIELD.

A steady decline in the flax industry of Ireland is noted, notwithstanding the repeated efforts of late years to revive it. Strange as it may seem, however, Belfast still maintains its prominence in the linen trade, while for years the native sources from which it was accustomed to draw its supplies of fiber have been contracting and growing less, so that to-day we find its manufacturers importing from the Continent millions of pounds' worth annually. It is not within the province of this report to discuss the economic causes which have produced such a serious revolution in the commerce of the country, for such a discussion would only lead to the consideration of systems and questions which may not properly come under consular review. While Belfast to-day exports its linen products to all countries of the globe, the material benefits of its trade have a local application only, instead of being felt throughout every section of the country where a pound of flax can be raised. This is the result of those singular conditions which have been forced upon the people by direct legislation, and which have gradually destroyed all the native industries and driven their natural products off the face of the land. It has been ascertained by Professor Sullivan, of Cork, that the soil and climate of Ireland can not be excelled for the production of flax, and yet Belgium, Russia, and Holland supply millions' worth of the fiber every year to the linen manufacturers of Belfast. It is said on good authority that, were the internal affairs of the country properly managed and this important industry properly encouraged and supported, the Irish flax producers would soon be able to drive their foreign competitors out of the market and turn to their account every year from $50,000,000 to $75,000,000. It would also enable them to export a large quantity of flax of a superior grade.

In an interesting article on this subject Professor Sullivan writes:

> I have examined all the soils of Europe and of nineteen American States; none of all these possesses the properties for the production of fiber equal to the soil of Ireland.

A writer in one of the magazines for March takes up the subject, and locates the cause of failure among the farmers themselves, charging their methods with the greatest part of it. It must be remembered that these very causes are in themselves but the effects of other causes which invoke conditions and circumstances which are, unfortunately, a part of the political management of the country. The poor farmer is always found between forces, which, operating like millstones, have ground the very life out of him, until there is very little of either him or his name left in the country. He gets none of that encouragement of material aid that might enable him to elevate either himself or his methods in the struggle against superior powers and superior advan-

tages. Hence he is left to toil and spin in vain, while the Dutch and the Belgians and the far-off Russians step in with their products and carry off the money that should flow into his pockets to improve his lot, enrich his country, or brighten his own home.

It is contended in this magazine article that the failure of the Irish flax in the native market can be explained only by the defective way in which the crop is cultivated. The writer says:

> In Ireland the farmers produce the crop and prepare it for the cloth manufacturer. In Belgium, in Holland, and in Russia, on the other hand, the farmer concerns himself solely with the cultivation of the crop. The preparation of the fiber is in the hands of persons specially skilled and trained in the work. The continuance in Ireland of the old system is known to entail much loss and waste, while it is seemingly on account of the greater efficiency and higher quality arising from the division of labor that the Belfast manufacturers so frequently prefer the foreign to the home-grown article. After the farmer has sown the seed and gathered the crop several processes remain before the flax can be used in the cloth mills. The most important are technically known as "steeping" and "scutching." By steeping is generally meant sinking the straw in deep water. Different methods of steeping prevail in different countries, according to local circumstances. In Holland stones are scarce, so the flax has to be laid on the surface of the water and then covered with mud raked up from the bottom of the water. The finest flax in the world comes from Courtrai, in Belgium, where the fiber is steeped in the River Lys, whose velocity is only at the rate of 3 miles an hour. The straw is sunk packed in crates, and for many miles both banks of the river are used as steeping grounds. In Russia, on the other hand, the flax is merely spread upon the ground and the rain is left to do the steeping. On Irish flax farms the straw is thrown into pits or wells with the seed still on it, the farmers not having learned the continental trick of saving the seed and yet getting good fiber. Much expense is consequently incurred in obtaining seed from abroad. On the Continent, too, the method of "scutching" is widely different, the yield of fiber being usually wider and better. So general is the necesary technical knowledge, that in the scutching mills the labor is mostly that of girls and lads from 17 to 20 years old, instead of men, as in Ireland, earning 30*s*. a week. Both the cheapness and the efficiency of the labor is said to be due to the separation of the functions of the producer from what are really those of the manufacturer.
>
> There are two methods by which this is accomplished: The farmer may buy the seed and sow it on his land in order to sell it to the factor, who will prepare the flax for the market; the factor, on the other hand, may himself provide the seeds and hire the land from the farmer, whose remuneration for preparing the land, sowing the seed, etc., will be included in the rent. It is to the adoption of one or the other of these plans that some people in Ireland are looking for a revival of what should be one of its most important industries. At the present time the crop is only cultivated to any extent in seven out of thirty-two counties, the production of flax in all the southern counties being quite insignificant. The average crop of the seven counties is worth £800,000 per annum; so that if the other twenty-five counties were producers in the same proportion, Ireland's flax industry, regardless of the seed that should be saved under an improved system, which would of itself represent a considerable sum, could be made to realize an income of between £3,000,000 and £4,000,000 yearly. As a matter of fact, the experts are of opinion that with its well-watered valleys the south of Ireland is even better adapted to the production of flax than the north. Before the farmers of the south can supply Belfast market with fiber equal to that which is now imported from across the seas, there must, it is thought, be some intermediate agency by which the preparatory process could be undertaken. Some 2 years ago a Belfast manufacturer made a very successful experiment with flax-growing in the south on

the continental system. He rented 60 acres of land near Cork, which he had prepared for a flax crop; last season the land yielded 80 stones of fiber of the value of 10*s*. per stone and seed to the value of £6 per acre, the profit being over 300 per cent. This is probably an exceptionally favorable result, but it certainly shows that under proper conditions the production of flax in the southern part of the island can be made to yield wealth beyond the Irish farmers' dreams of avarice.

It is proposed to give the continental system a trial in Tipperary. Mr. Dickson, a member of Parliament, has guarantied a fund to start it with 100 acres. Its success would undoubtedly lead to the revival of a very important industry for the Irish people.

WILLIAM P. SMYTH,
Commercial Ageut.

UNITED STATES COMMERCIAL AGENCY,
Huddersfield, March 6, 1891.

NEW ZEALAND FLAX.

REPORT BY OONSUL GRIFFIN, OF AUCKLAND.

[From Consular Reports No. 11.]

New Zealand flax (*Phormium tenax*) is by far the most valuable fibrous plant indigenous to this colony. It has been an article for export ever since 1809.

The attention of Europeans was first directed to it by the great navigator, Captain Cook, who described it as something superior to either flax or hemp. The natives, or Maories, have for many years used it for binding together the framework of their houses, and for making clothing, baskets, fine mats, fishing nets and lines, and sails for their boats and canoes. The name *Phormium tenax* is derived from the Greek word *Phornos* (a basket), and *tenax* (strength). It belongs to the liliaceous family of plants, a species of plants whose history can be traced from the earliest ages. It is mentioned in the book of Exodus as one of the productions of Egypt in the time of the Pharaohs, and it has been ascertained that the cloth in which the Egyptians enfolded their mummies was made of this plant. Herodotus frequently refers to it, and mention is also made of it in the New Testament. Our Savior once selected one of the flowers of the *Lilium chalcedonicum* as an emblem of beauty.

Phormium tenax is sometimes called the flax lily. The leaf varies in size from 3 to 14 feet in length, and from one-half inch to 5 inches in breadth at the widest part. It grows in bunches or groups of plants; each shoot has five leaves. On an average, about ten of these shoots form a bunch. The leaves are perennial, hard, and sword shaped, with a stalk rising 5 or 6 feet above them bearing a profusion of yellow and sometimes red flowers, followed by triangular seed vessels filled with flat and thin black shining seed. The plant attains its full growth in 3

years, when the leaves generally split at the end, and it first comes into flower. It is said that in rich soil the flower rises to a height of 20 feet.

The leaves are smaller in structure than those of European flax and hemp plants, being composed of cellular trusses running the whole length of the leaf, incased in a green substance. The trusses consist of two parts, wood and bast, the latter forming the fiber so highly prized. The fibro-vascular bundles compose the inner bark of the plant, and serve to circulate the juices which are taken from the soil by the roots. They consist of exceedingly fine threads, one lapping over the other in such a manner as to give a free circulation throughout the leaf. The plant is indigenous only to New Zealand and Norfolk Island, although it has been transplanted in India and other countries, and is said to grow on the Pacific slope of the United States. It grows best in rich, moist, and well-drained ground. It reaches the greatest size on the banks of running streams.

When the leaves are full grown, the natives gather them when green and separate the fibers. They scrape the leaves with a shell, and then divide them with a comb. They are then put in the sun to dry, and when dry are perfectly white, soft, and silky to the touch.

It takes but little time to prepare the fiber; the plant may be shorn of its leaves in the morning, and before the sun is set the fibers are ready for weaving into cloth. The natives produce about 1 ton of fiber out of 4½ tons of green leaves. A full-grown plant will produce on an average about 36 leaves, besides offshoots from the roots, and it takes about six leaves to yield one ounce of fiber. At this estimate an acre of ground, planted 3 feet apart, would yield about 16 cwt. of fiber. When cultivated, the yield is about 2½ tons per acre.

DIFFERENT VARIETIES OF PHORMIUM TENAX.

The list of names of the different varieties of *Phormium tenax* distinguished by the natives is a very long one. It embraces *aonga*, a varigated flax described by Bishop Selwin; *atewhiki*, a very white fiber used for making fine mats and garments, the leaf is narrow with a reddish tinge, edge and keel narrow, bright scarlet lines; *sapoto*, cultivated at Coromandel, Kawhia, and Waikata—glossy leaves, rather red at the edge, has a general orange-green appearance at a distance; *sarariki*, a species of very fine and soft texture used for making ornamented mats, the leaves tapering, of a dull olive-green, lighter on the other side, dark-red keel and edge, and a keel on the upper side, gradually shaded away. forming a dark-colored band one-eighth to three-eighths of an inch broad; about 2 or 3 inches of the point of the leaves are of the same dark color.

Two varieties of *Phormium tenax* are described in the New Zealand flora. Dr. Hochsetter makes the following classification:

Sihori, a cultivated kind; *suhari*, swamp flax; and *whaririki*, hill flax. The first named, *sihori*, is regarded as the best variety; it is used only for the finest work by the Maories; it seldom grows to a greater height than 5 feet. *Suhara*, or swamp flax, grows to a height of from 10 to 12 feet; it bears a red flower about half an inch longer than the *sihori*, the seed-pods are also larger, and the scape is of a dark-red color. This flax may be distinguished from the other species by its bright color, sturdiness, and the nature of its fiber. *Whaririki*, or hill flax, is said to possess but a small proportion of fiber, and that of a very coarse kind. It is said to be cultivated in the coldest parts of the South Island, but it does not appear to be used for manufacturing purposes.

DIFFICULTIES IN THE PREPARATION OF THE FIBER.

The greatest difficulty in the preparation of the fiber of *Phormium tenax* is to do away with the gummy or mucilaginous products found in the leaf. Captain Hutton is of the opinion that what is ordinarily spoken of as the gum is, in reality, at least three different products, viz: First, the gum on the outside of the lower part of the leaf; second, the bitter principle and mucilage contained in the cells of the leaf; third, the cement that binds the ultimate fibers together into bundles. He found, while experimenting, that the gum softens, but does not dissolve in cold water, and that it readily dissolves in boiling water. The bitter principle is easily overcome by cold water.

The cement dissolves in boiling water, and more quickly in alkalies. Acids which dissolve the gum have no effect upon the cement. Hutton says:

> The strength of the fibrous bundles depends entirely upon the cement that holds the ultimate fibers together; and if this is dissolved, either by hot water or alkali, the whole would separate into a mass of fluff, with no coherence or strength.

It appears from a report on the chemistry of *Phormium tenax*, by Prof. A. H. Church, that the fiber contains much matter soluble in water, or liable to change. This accounts for the decay of rope made with this material. Professor Church says that the use of a mixture of lubricating or machinery paraffine oil with wood tar seems to prevent the entrance of sea water and the proneness to change in phormium fiber. He suggests that the fiber should be immersed in sulphuric acid of the consistency of that used in the manufacture of vegetable parchment for the purpose of toughening and strengthening it. Professor Church is opposed to the use of akaline matters at a high temperature in the treatment of the fiber, from the fact that it tends to destroy the oil and otherwise injure the fiber. He does not think that the ultimate fibers are held together by any cement, but by their cell walls.

STRENGTH OF NEW ZEALAND FLAX.

New Zealand flax is generally supposed to be the strongest fiber in the world, but such is not the case. Recent experiments with testing

machines show that, while it is more than double the strength of ordinary hemp and flax it is not as strong as silk.

I give below a table furnished me by Mr. S. Cheeseman, of the New Zealand Institute, showing the comparative strength of various kinds of fibers.

Table showing the strength of various fibers.

	Pounds.
Silk will bear a strain of	34
Phormium tenax, a strain of	23 7/16
Russian hemp, a strain of	16¾
Common flax, a strain of	11¾
Agave americana, a strain of	7

This table does not vary much from that given by Professor Lindley, which is as follows:

	Pounds.
Silk will bear a strain of	34
Phormium tenax, a strain of	23
European hemp, a strain of	16
European flax, a strain of	11

EXPORT OF FLAX.

In 1837 there was exported from New Zealand 1,062 tons of *Phormium tenax*, the value of which was $106,200. In 1864 the export increased to 2,228 tons, with a value of $302,950. The largest export occurred in the year 1873, when the quantity was 6,454 tons and the value $718,975.

I give below a table showing the quantity and value of flax exported from New Zealand for each year since 1871:

Table showing the quantity and value of Phormium tenax exported from the various ports of New Zealand for each year from 1869 to 1880, inclusive.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1871	4,248	$453,055	1876	897	$91,425
1872	3,987	497,025	1877	1,053	94,130
1873	6,454	718,975	1878	622	53,331
1874	2,038	188,450	1879	445	39,370
1875	639	58,710	1880	894	78,085

FLAX MILLS.

The latest complete returns I have of the number of flax mills in New Zealand is for the year 1878. During that year most of the mills were worked for only a portion of the year. The industry, owing to the low price realized for dressed flax, was in a declining state. I append hereto a table showing the number of flax mills in operation during the year ending March, 1878, with the number of machines, the power and num-

ber of hands employed, and the quantity of flax manufactured during the year.

Provisional districts.	No. of mills.	No. of machines.	Horse-power.	Em-ployés.	Quantity manu-factured.
					Tons.
Auckland	19	25	134	172	642
Wellington	1	1	14	4	10
Marlborough	5	6	45	36	297
Nelson	1	1	30	12	60
Canterbury	2	4	9	28	165
Otago	3	3	19	10	16
Total	31	40	251	262	1,190

It will be seen from this table that Auckland has a larger number of flax mills than all the other provincial districts of the colony put together. I am informed by Mr. J. M. King, who is now engaged in compiling the census returns of Auckland for the year ending April, 1881, that the returns indicate a more prosperous condition of the flax mills than the colony has enjoyed since 1874, and that the number of mills and hands employed therein are largely in excess of those of 1880. These mills are used principally for dressing the flax for rope making.

I learn from the commissioners' report on flax that the green leaves are stripped by revolving rollers with projecting beaters traveling at a high rate of speed, which crush the epidermis against a fixed plate, so set as to allow room for the fiber to remain intact. The fiber, thus freed from the leaf of the plant, is washed by various methods, put on the ground or on lines to dry and bleach, finished by an arm or barrel scutch, and, when boiled, is ready for market.

All the machines used are identical in principle and vary only in the details by which the principle is carried out. This principle is that the leaf is held between horizontal feed rollers, revolving at a certain speed, while, as the leaf passes out from them, a drum armed in its circumference with iron beaters, and revolving more rapidly than the feed rollers, strips the epidermis and tissues away from the fiber, means being provided for adjusting the beating drum to a proper distance from the roller or bar against which the phormium leaf is stripped, so that the leaf may neither on the one hand pass through without being crushed, nor, on the other, have the fibers cut.

PREPARATION OF THE FIBER BY THE NATIVES.

The method of preparing the fiber by machinery is certainly a great improvement over that of the Maoris, because the waste is nothing like so great. Indeed, the Maoris do not obtain from each leaf one-fourth of the quantity that would be secured in machine dressing. The natives cut off the leaf about six inches below the point where the two blades adhere together and reject the colored edges; they so take much time

and pains in preparing the leaf, often soaking it four or five days in running water and then beat it with a stone or mallet. This process is repeated over and over again for four or five weeks. They can not be made to understand the value of time. It is certain, however, that the fiber dressed by the natives is far more valuable and beautiful than that prepared by machinery.

COMPETING FIBERS.

The principal competing fiber with *Phormium tenax* is manilla hemp, of which such vast quantities are used in the United States. Manilla hemp is a native of the Philippine Islands. It is made from a species of plantain called *Musa textiles*. It is planted generally on the slopes of hills, and requires shade and plenty of moisture. The trees are planted about eight feet apart, and are cut down at the end of the third year and made into fiber. A full grown tree will yield about 1½ pounds of hemp.

It does not appear that machinery has ever been used successfully in its manufacture, although many inventions have been made for the purpose, but the hemp for the most part continues to be produced by manual labor.

The process of manufacture is described as follows: The tree is cut down and stripped of its linings; these are then cut into pieces three or four inches wide, after which they are drawn underneath an instrument resembling a saw fixed in a block of wood. The fleshy part of the cortex is scraped off, and the fiber alone remains, which is then placed in the sun to dry. Two persons, one engaged in cutting down the trees and stripping them and the other in extracting the fiber, can work up about 25 pounds of clean hemp in the course of one day. The greatest objection to rope made of New Zealand flax is that it becomes unfit for use after it is once wet, although there is no doubt that it will last longer than any other kind if kept dry. On the other hand, rope made from manilla hemp is actually improved by getting wet.

NEW ZEALAND FLAX IN THE AZORES.

Phormium tenax, I learn, is now being cultivated extensively in the Azore Islands. A company has been established there composed of two Englishmen and two Portuguese. One of the latter is stated to be the holder of a concession from the Government of a monopoly for the manufacture of this article throughout Portugal and all Portuguese possessions, which concession the company are to buy of him for £15,000 in shares, being one-half the nominal capital of the company, the vendor agreeing not to receive any dividend until the other 15,000 shares shall have received six per cent.

CULTIVATION OF FLAX IN NEW ZEALAND.

It is more than probable that the cultivation of *Phormium tenax* in New Zealand will soon become a profitable industry. The rapid spread

of colonization and the alienation of the waste lands of the crown to private proprietors have very much narrowed the source of supply of wild flax, which principally grows most luxuriently in soil that is selected by the settlers for agricultural purposes. Of course, as the stock of wild flax becomes scarce the necessity for cultivating the plant becomes greater. Experience proves that the wild flax will soon become insufficient for the demand, and due consideration must be given to the fact that flax, like nearly all other plants, can be improved by cultivation.

EXPORT OF FLAX TO THE UNITED STATES.

Very little New Zealand flax is shipped direct to the United States What reaches there generally goes by way of London. There was but one small direct shipment to America from Auckland in 1879, and none at all in the year 1880. The duty charged upon the imports of New Zealand flax into the United States is only $5 per ton, and ought not to interfere materially with its shipment to America. It may be, however, that it can not compete successfully with manilla or some of the various kinds of hemp grown in the United States.

G. W. GRIFFIN,
Consul.

UNITED STATES CONSULATE,
Auckland, June 15, 1881.

NEW ZEALAND FLAX.

REPORT BY CONSUL CONNOLLY, OF AUCKLAND.

[From Consular Reports No. 116.]

Inasmuch as flax fiber has become an article of considerable commercial importance in New Zealand during the past year, I have endeavored to procure some of the seed, which I forward herewith,* together with such information as I have been able to obtain in relation to the cultivation of the fiber. The purchase of New Zealand flax by the United States has largely exceeded that of any other country during 1889. I have therefore deemed it my duty, in view of the immense commercial value to which this exclusively New Zealand product has attained during the brief space of one year, to acquaint the Department of its growing importance as an article of export to the United States and other countries.

I am convinced that if handled with intelligence and care the *Phormium tenax* plant can be successfully and advantageously cultivated in the United States. The climate and swamps of many of the Southern States are peculiarly adapted to the propagation of New Zealand

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* Sent to the Department of Agriculture.

flax. The climate of California is also suitable for the cultivation of the flax plant. *Phormium tenax* is indigenous to New Zealand, Norfolk Islands, Chatham Islands, and other smaller islands situate between between 30° and 50° south latitude. The most robust and finest plants are to be found between 35° and 41°. It grows on any soil from the sea-level to an altitude of 2,000 feet; but it is found in the greatest luxuriousness in swamps and on the banks of rivers and lakes. The leaf or blade often attains the length of 15 feet and from 2½ to 3 inches in width. Before the Maoris adopted European clothing considerable care was bestowed on the selection and cultivation of the plant by them. They dressed it by a process of steeping and scraping and hand scutching, which produced a fiber almost as fine and glossy as floss silk, of which they wove their mats and "kakahu" (clothing). But of late years, since the Maoris have learned they can procure their clothing from their European neighbors with much less effort than they could manufacture it with the primitive methods at their command, no steps have been taken for the conservation of the better varieties.

The seed accompanying this paper is of a superior quality, was procured for me by a Mr. Jeffs, who has lived in this colony for nearly 40 years and who is thoroughly familiar with the flax industry of New Zealand. It may be proper to state that Mr. C. K. Jeffs, of Onehunga, New Zealand, is willing to furnish seeds and practical information to any one desiring to engage in the cultivation of *Phormium tenax* in America. The seed above referred to was obtained from an old Maori cultivation, and is highly prized by those natives who still devote their attention to the weaving of mats and other useful ornaments manufactured from the fiber.

The flax used for export is usually cut from the swamps, marshes, and river banks. It is in its wild, uncultivated state, and it is cut down and run through the machines without any attempt at selection. This is much to be regretted, as with a little care, even with the crude machinery in use at present, a much finer article could be produced.

The persons usually employed to cut the green flax are paid by the ton. It is therefore to their interest to get as much weight as possible, and, in consequence, they cut as close to the ground as they can. The lower end of the leaf is thick and fleshy, containing a large amount of gum and vegetable matter, and weighs heavily as compared with upper portions of the leaf; besides, the fiber obtained from the butt end is very much inferior in texture to that procured from the body and top of the blade.

To imperfect machinery and carelessness in the selection of green plants may be ascribed the apparent coarseness and inferiority so often complained of in the flax exported from certain portions of New Zealand. But with improved flax-dressing machinery and proper care exercised in the selection of the raw material a very superior article can be produced. The *Phormium tenax* fiber is susceptible of a much higher de-

gree of preparation than has been bestowed upon it up to the present. This, however, is not altogether the fault of those who are engaged in its manufacture; it is for want of the necessary machinery. The hand-dressed article prepared by the natives is as fine as silk as compared with the modern machine-dressed flax of to-day. This only demonstates the fact that the fiber may be reduced to a much finer quality, and all that is necessary to do this is an improved machine. If the New Zealanders can not produce the requisite machinery I trust the inventive genius of America will come to the rescue. There is certainly a splendid opportunity and a fortune for any man who will invent a machine that will successfully and economically reduce New Zealand flax to a proper degree of fineness.

Many who profess to thoroughly understand the toughness and durability of the *Phormium tenax* believe that if it could be properly reduced it would enter largely and successfully into the manufacture of valuable textile fabrics.

The quantity of seed I have forwarded to the Department, I am reliably informed, is nearly sufficient for an acre of ground, and with ordinary care in its cultivation will be in proper condition to send to the "flax-mill" at the expiration of 3 years from the date it is put in the ground. It takes about twelve hundred healthy plants to the acre, and, to use Mr. Jeff's expressive language, "in 3 or 4 years it would be so close you would hardly be able to ride a horse through it."

For additional information on the subject reference to my report to the Department, dated December 31, 1889, may be of some value.

JNO. D. CONNOLLY,
Consul.

UNITED STATES CONSULATE,
Auckland, March 6, 1890.

LINSEED IN INDIA.

REPORT BY CONSUL-GENERAL MERRILL, OF CALCUTTA.

[From Consular Reports No. 126.]

The seed obtained from the cultivated plant *Linum usitatissimum* is known as linseed. The linseed cultivated in India up to altitudes of 6,000 feet above the sea is oil-yielding.

Experiments extending through years prove that the climate of this country is not as favorable as that of Europe for the production of the best flax fiber, also that a certain apathy or dislike of change among the peasantry will prevent the cultivation of this plant for anything but the seed. Though much has been done by the Government for the production of flax and hopefulness of success has been indulged, the result has not been commensurate with the efforts put forth nor with the hopes entertained. Jute holds the place of flax in popular favor.

Linseed is grown on all the different classes of soils comprised between the lighter clay and sandy loam. It does not do as well in stiff clay as in light sandy soils, but thrives on the heavy black cotton soil of which the level plans of this country are formed, similar to the land in southern Louisiana were there in this Mississippi delta a stronger admixture of clay. The valley lands receive three or four plowings and two or three harrowings. Linseed should not be buried deep; otherwise it will not germinate properly. The seeds are, therefore, not plowed in, but simply covered by passing a drag over the field once or twice. It can be sown alone or with wheat, grain, or mustard. Sometimes all of these crops are grown together. When sown with such a crop as grain or wheat, the plan adopted is this: After wheat or grain has been sown the land is plowed; linseed is now sown broadcast and the operation is finished by using the drag or ladder twice.

On the lighter clay land the method for growing linseed is the simplest imaginable. As soon as the rice field has become sufficiently dry, linseed is sown broadcast on the standing rice. The rice is harvested as usual, the linseed being left to be reaped about the last of March.

In some districts it is grown on land which is under water during the rains, and in this case its cultivation is of the roughest possible description, there being no preparatory plowing, but the seed being simply scattered over the ground and plowed in. Yet it is acknowledged that the land must be well drained, as stagnant water is very injurious to the crop. When linseed occupies the land alone, from 15 to 20 pounds of seed is used; but, when it divides the soil with other plants, only half as much is required.

Among the varieties of linseed there are two important kinds—the white and the red—which seem, in ordinary nomenclature, to be all-embracing. A slight preference is expressed for the former, as it is said to yield a little more oil and to yield it more easily than the latter, while the cake is softer and sweeter than that produced from the red seed.

It is impossible to arrive at definite information in regard to the actual area devoted to the cultivation of linseed, owing to the very general habit of raising it as a mixed crop. If intended for local consumption, it is frequently grown along with mustard, both seeds being expressed at once for their mixed oils. It is often, also, grown with nonyielding-oil crops in lines through the fields or in broad borders around the edges. It is estimated, however, that in all British India nearly 5,000,000 acres are now occupied by the present crop. The average outturn per acre from year to year is from 250 to 400 pounds, though in a few districts, such as Bustee and Goruckpoor, double this amount is claimed.

The arch enemy of this plant is rust, from which it always suffers in damp seasons. As linseed is sown in October and harvested in February, March, and April, it will not do at this early date to make esti-

mates in regard to the coming product. It can be safely said, however, that more space has been given to it this year than last, that the ground was in good order, that the seed germinated well, that the weather has been favorable, that the crop is growing finely, and that everything promises a good outturn.

Pure linseed oil has not an extensive demand in India, there being practically but one linseed-oil mill in all this region. The oil cake does not seem to be appreciated as a food for cattle; consequently almost the entire production is exported. The first exportation was in 1832 and amounted to 10 bushels. In the year ended March 31, 1861, it was 550,700 cwts.;* in 1881, ended as above, 5,997,172 cwts.; and during the year ended March 31, 1889, 8,461,374 cwts.

The subjoined table sets forth the imports into the chief seaports from the interior during the three years 1886–1889.

Exports take place chiefly in the quarter ended on the 30th of June.

The United Kingdom receives about 65 per cent. of its total supplies of linseed from India, the remainder going chiefly from Russia. In 1851 the total demand in Great Britain amounted to only 630,471 cwts., whereas in 1889 India alone furnished the United Kingdom 5,295,175 cwts.

During the year ended March 31, 1890, the exports of linseed were as follows:

Countries.	Quantity.	Countries.	Quantity.
	Cwts.		*Cwts.*
United Kingdom	4,342,962	Egypt	129,102
Austria	2,000	United States	772,758
Belgium	254,033	China	17,514
France	929,725	Austria	11,166
Germany	24,503	Other countries	420
Holland	324,943		
Italy	328,743	Total	7,146,896
Portugal	9,027		

Of the above, 5,124,285 cwts. were exported from Bengal, 2,013,169 cwts. from Bombay, and 9,442 cwts. from Sind.

During the eight months beginning April 1 and ended November 30, 1890, the following amount of linseed was exported:

Countries.	Quantity.	Countries.	Quantity.
	Cwts.		*Cwts.*
United Kingdom	2,772,488	United States	618,750
Belgium	225,009	Other countries	153,085
France	846,391		
Holland	588,630	Total	5,412,694
Italy	208,341		

From April 1 to December 15, 1890, the shipment from Calcutta to the different United States ports was as follows: New York, 551,060 cwts.; San Francisco, 65,394 cwts.; Philadelphia, 74,994 cwts.

*1 cwt. = 112 pounds.

The value of linseed has more than doubled since 1840, but of late years the price has varied but little.

The following table shows the price in Calcutta for the past five years per maund* of 82 pounds:

Year.	January.	July.	Year.	January.	July.
	Rs. A. P.	*Rs. A. P.*		*Rs. A. P.*	*Rs. A. P.*
1886	4 8 0	4 8 6	1889	5 9 0	5 6 0
1887	4 8 0	4 7 0	1890	4 14 0	.....
1888	4 4 0	4 3 6			

NOTE.—Rs. A. P. at the head of money column signify rupees, annas, and pice; 12 pice = 1 anna, 16 annas = 1 rupee = 40.4 cents.

In preparing the above report I have been kindly given access to the proof sheets of Dr. Watt's great work on "The Economic Products of India."

Table showing the imports of linseed by rail and river into Bombay, Karachi, and Calcutta during the three years 1886–'87, 1887–'88, *and* 1888–'89.

Provinces whence imported.	Into Bombay.			Into Karachi.		
	1886–'87.	1887–'88.	1888–'89.	1886–'87.	1887–'88.	1888–'89.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bombay	35,240	25,328	27,738	.....	.....	.....
Sindh	.....	.....	.....	44	.....	5
Bengal	.....	.....	33	.....	.....	.....
Northwest Provinces and Oudh	35,769	11,373	16,264	.....	2	53
Punjab	1,525	102	149	61	34	60
Central Provinces	39,008	24,036	27,738	.....	.....	.....
Rajputana and Central India	33,101	28,546	23,681	.....	.....	.....
Berar	25,787	22,402	28,397	.....	.....	.....
Other provinces	9,346	10,369	10,161	.....	.....	.....
Total	179,776	122,095	134,161	105	36	118

Provinces whence imported.	Into Calcutta.			Total.		
	1886–'87.	1887–'88.	1888–'89.	1886–'87.	1887–'88.	1888–'89.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bombay	.....	.....	.....	35,240	25,328	27,738
Sindh	.....	.....	.....	44	.....	5
Bengal	220,755	228,933	199,098	220,755	228,933	199,131
Northwest Provinces and Oudh	60,593	59,576	74,698	96,362	70,950	91,015
Punjab	.....	41	252	1,586	177	461
Central Provinces	213	222	138	39,221	24,258	27,876
Rajputana and Central India	629	2,754	587	33,730	31,300	24,268
Berar	.....	.....	.....	25,787	22,402	28,397
Other Provinces	1,603	2,017	2,311	10,949	12,326	12,472
Total	283,793	293,543	277,084	463,674	415,674	411,363

SAMUEL J. MERRILL,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Calcutta, January 7, 1890.

*There are two sets of weights in Calcutta, viz, the factory and the bazaar. The factory maund is equal to 74,667 pounds; the bazaar maund, the weight used by the consul-general, is 10 per cent. greater than the factory maund.

LINSEED IN THE ARGENTINE REPUBLIC.

REPORT BY CONSUL BAKER, OF BUENOS AYRES.

[From Consular Report No. 125.]

The flax industry in this country is only a very recent branch of its agriculture. It is only within the last few years, indeed, that it has had any development at all, and as yet there is very little to be said about it.

A COMPARATIVELY NEW INDUSTRY.

As late as 1877 the custom-house returns do not show that a pound of the seed had ever been shipped from any Argentine port. In 1878 the exports amounted to 35 tons; in 1880 the amount shipped had increased to 958 tons; in 1881 it was 6,394 tons; in 1882 it was 18,644 tons; and in 1883 it was 23,061 tons. About this time, owing to the steady foreign demand and the good prices which were obtained for the seed, a very general interest was manifested, not merely in the production of the linseed for foreign consumption, but also in the preparation of the fiber. Since then, with the advent of agricultural laborers from Europe, there has been a gradual increase in the breadth of land under this crop, the yield of which is variously stated to be from 20 to 40 for one, and for which the country seems to be very well adapted.

The range of the exports of linseed since 1883 will be seen from the following table:

Year.	Quantity.	Year.	Quantity.
	Tons.		*Tons.*
1884	33,991	1888	40,222
1885	69,426	1889	28,195
1886	37,689	1890 (9 months)	30,542
1887	81,204		

BREADTH OF LAND IN FLAX CULTIVATION.

The cultivation of linseed, however, is as yet almost exclusively confined to the provinces of Santa Fé and Buenos Ayres, though a little is now also grown in the province of Entre Rios. In 1881 the amount of land under flax cultivation was as follows, in hectares: Province of Buenos Ayres, 29,192; province of Santa Fé, 6,122; total, 36,314. In 1889 the breadth of land under this crop was as follows, in hectares: Province of Buenos Ayres, 43,899; province of Santa Fé, 73,009; province of Entre Rios, 4,161; province of Rioja, 34; total, 121,103. As the total area of land under crop cultivation in the Argentine Republic is 2,422,995 hectares, it appears that the amount at present put down in flax is only about 5 per cent. of the whole.

AMOUNT OF THE HARVEST.

I am unable to answer your inquiry as to the total amount of flax produced in the Argentine Republic. There is no way of obtaining the information, as the Argentine Government has no provision for crop reports. We can only estimate, and it is estimated that the harvest in the province of Santa Fé last year amounted to 56,887 tons, while that of Buenos Ayres was about 25,000 tons; total crop, say, 100,000 tons, including Entre Rios. In regard to the approaching harvest, it is stated that the acreage is larger than ever before, and, unless some misfortune overtakes the crop, the yield will show a very considerable increase over that of any previous year.

THE COMING CROP.

What the shipments will be, however, will depend a good deal on the price abroad, for there is now an annually increasing home market for the crop, as several oil mills have recently been established in the country, and great hopes are entertained that the production of linseed oils will henceforth be added to the category of national industries.

DESTINATION OF CROP.

The next crop will be harvested and ready for shipment about the 1st of March, and the business will probably run through the quarter ending June 30, 1891. The shipments will all go forward either from this port or Rosario. It is not possible to say whither the crop will be exported, but, as a general indication of the direction it will take, I give the following destinations which the shipments of 1888 and 1889, according to the custom-house returns, appear to have had:

Destination.	1888.	1889.	Destination.	1888.	1889.
	Kilograms.	*Kilograms.*		*Kilograms.*	*Kilograms.*
Germany	1,805,604	1,792,338	Holland		322,790
Belgium	3,490,721	2,623,180	Great Britain	27,650,030	12,289,203
Brazil	114,575	826,100	Uruguay		10,088
United States	2,123,470	6,755,263			
France	4,917,427	2,134,329	Total	46,222,888	28,195,816
Italy	121,061	1,422,525			

MARKET VALUE.

The price of linseed in this market during the last year, according to the returns of the Buenos Ayres Bolsa, ranged as follows: January 1 to March 31, 57 to 70 cents; April 1 to June 30, 45 to 65 cents; July 1 to September 30, 45 to 75 cents; October 1 to December 31, 60 to 80 cents in current money per 10 kilograms. So far during the present year there has been a slight increase in the price.

CONDITIONS OF FLAX CULTIVATION.

As to the mode of cultivation here, I am but indifferently posted; but if it differs at all from that employed in the United States, it is certainly not for the better. I assume this to be so for the reason that no crops in this country receive that care and attention which good husbandry exacts. I may add that the crop is not a favorite one, although it is believed to pay well for the reason that it is thought that the cultivation very rapidly exhausts the land, so that most of the production is by those who do not own, but only rent, their farms.

It is only necessary to add, in regard to soil and climate, that flaxseed culture is exactly under the same conditions as that of wheat or corn.

E. L. BAKER,
Consul.

UNITED STATES CONSULATE,
Buenos Ayres, November 20, 1890.

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52D CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { MIS. DOC. No. 20.

SPECIAL

CONSULAR REPORTS.

Volume III.

STREETS AND HIGHWAYS IN FOREIGN COUNTRIES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1891.

SPECIAL CONSULAR REPORTS.

STREETS AND HIGHWAYS

IN

FOREIGN COUNTRIES.

REPORTS FROM THE CONSULS OF THE UNITED STATES ON STREETS AND HIGHWAYS IN THEIR SEVERAL DISTRICTS, IN ANSWER TO A CIRCULAR FROM THE DEPARTMENT OF STATE.

ISSUED FROM THE BUREAU OF STATISTICS, DEPARTMENT OF STATE.

ALL REQUESTS FOR THESE REPORTS SHOULD BE ADDRESSED TO THE SECRETARY OF STATE.

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STREETS AND HIGHWAYS IN FOREIGN COUNTRIES.

CONTINENT OF EUROPE.

AUSTRIA.

REPORT BY CONSUL-GENERAL GOLDSCHMIDT, OF VIENNA.

HIGHWAYS.

In speaking of the construction, maintenance, and management of public roads in Austria a distinction must be made between the so-called Imperial or state roads, which are subject to the legislation and administration of the state, and the public streets and roads, which are subject to provincial legislation.

1. STATE OR IMPERIAL ROADS.

The principal regulations concerning the state roads have been given from case to case by special laws or orders. Of these may be mentioned provisional regulations for the maintenance of country roads, (order by the department of the interior of October 13, 1849, No. 415, E. B.); building and maintenance of those parts of imperial roads leading through communities (order by the department of the interior of March 20, 1855, No. 53); the clearing away of snow from state roads (law of January 2, 1877, R. G. Bl., Nos. 33, 34). In addition to this, order by the department of the interior of May 5, 1877, and of July 7, 1876 (R. G. B., No. 100).

The total length of state or imperial roads throughout the kingdoms and provinces at present represented in Parliament amounted in the year 1828 to 11,436 kilometres and in the year 1873 to 15,003 kilometres; therefore the increase in length in this time amounts to 24 per cent. of the latter figure. One square kilometre of state territory is consequently intersected by 0.0508 kilometre of state roads.

A. Construction of the State Roads.

Only the state roads of Bohemia and the Tyrol are throughout or with but few exceptions constructed in the manner of regular highways (Chausséen), that is to say provided with a stone foundation.

In the other provinces, as Moravia, Lower Austria, Upper Austria, Salzburg, Silesia, Styria, Carinthia, Carniola, Galicia, Bukowina, nearly all the state roads are constructed after the manner of country roads, that is without any stone foundation and built exclusively of ballast (broken stone).

In Lower Austria, for instance, only two-tenths of the state roads are built upon a stone foundation.

These state roads in the above provinces have as a rule originated from the old parish roads and ways, which in some cases have only been corrected and widened.

a. Transverse Section of the State Roads.

For the constructing of new state roads it is prescribed that the maximum breadth (even in the vicinity of large towns) should be 9.5 metres. Only the largest state roads, leading from the city of Vienna, have the exceptional breadth of 11.4 metres.

The normal transverse sections of the newly built state roads, which are all provided with a stone foundation, are shown in figures 1, 2, 3, and 4 of the annexed drawing.

As will be seen from the following drawings the width of the roadway varies, according to the importance of the road, from 6.3 to 8 metres, and the width of the banquette, on both sides, or in narrow valleys or ravines only on the valley side, from 0 to 1.6 metres.

The foundation pavement is from 24 to 32 centimetres, and the second ballast (of broken stones or gravel) placed thereon from 16 to 24 centimetres high. The convexity of the road surface is 1 in 50 to 1 in 30. The road ditch has an average depth of from 30 to 63 centimetres and a bottom width of from 30 to 63 centimetres. In the normal transverse section of the state roads for Moravia the foundation bed appears provided with exceptionally high bordering stones, which have the object of holding together the ballast.

The section of the state roads for Bohemia is essentially the same as that for Lower Austria, with the only difference that it has a width of roadway of 7.5 metres, a stone foundation of 37 centimetres, and a second ballast or covering of broken stones or gravel of 15 centimetres. The

five state roads leading from Vienna are in its immediate vicinity paved with granite cubes on account of the great traffic thereon. The total length of this paving amounts to 22,000 metres.

Fig. 1.

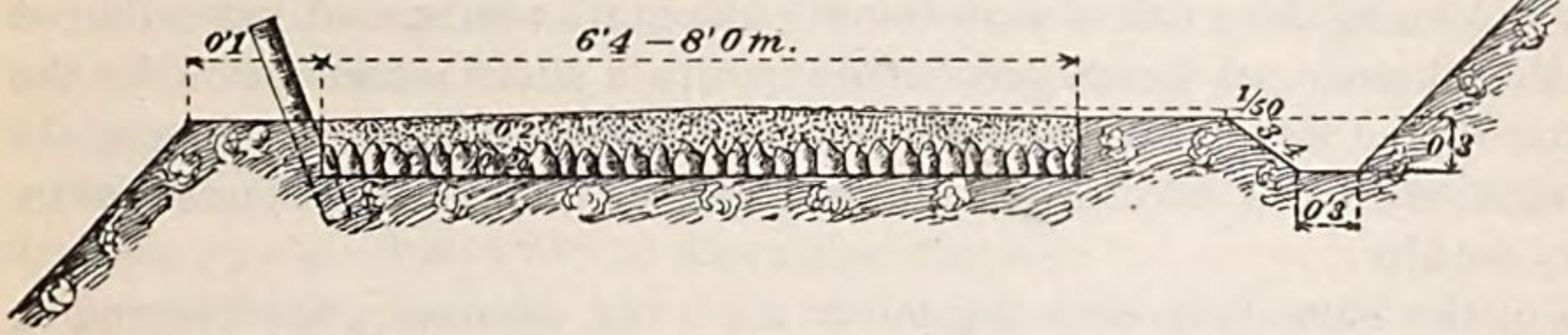


Fig. 2.

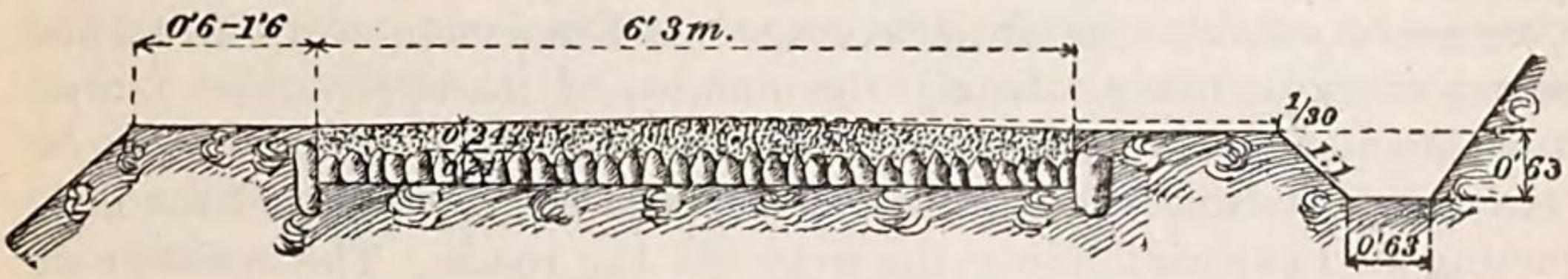


Fig. 3.

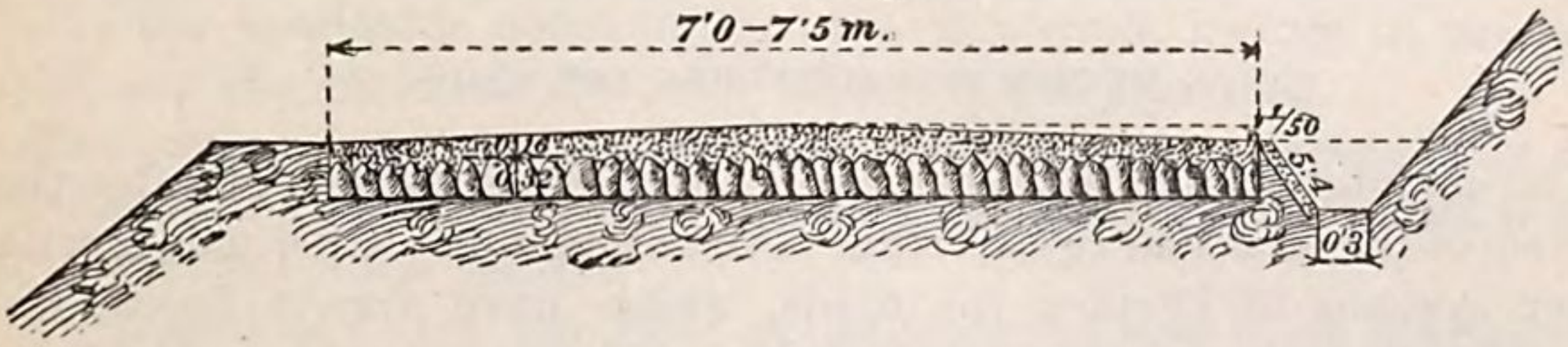
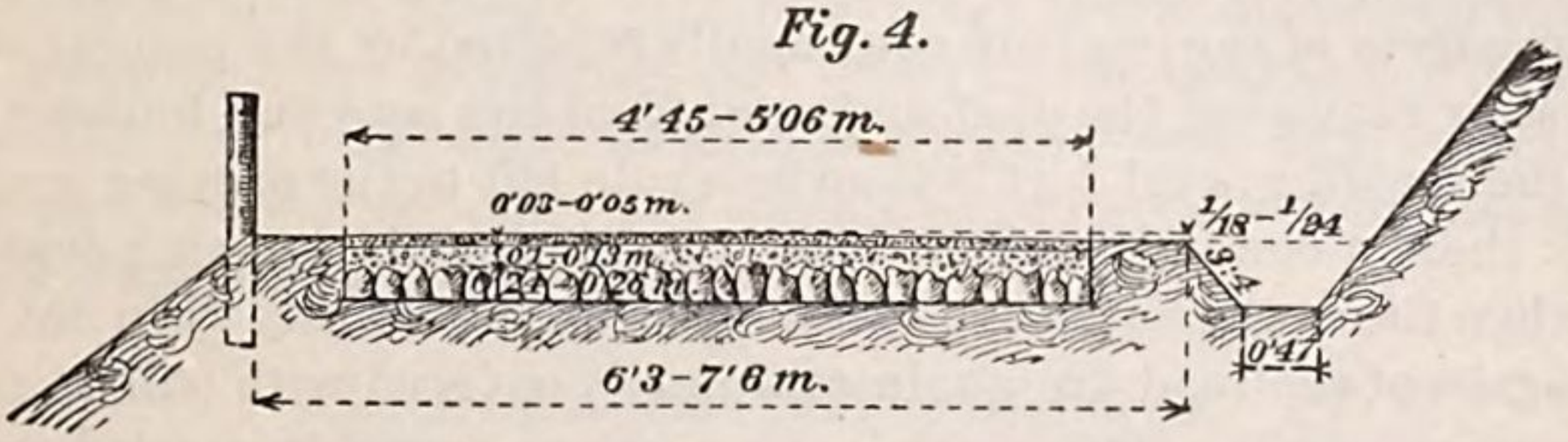


Fig. 4.



Closely connected with the width of the roads are the regulations of the road police, according to which, for instance in Lower Austria, Bohemia, Styria, and Carniola, the load of a wagon must not exceed 3 metres in breadth, while in Carinthia this maximum is fixed at 2.2 metres.

b. OTHER REGULATIONS.

Where there is a steep r ise or fall of ground along the banks of the road a sufficient number of safety posts or bars must be provided. In the beginning of winter temporary roads must be marked out with poles or branches of at least 2 metres height upon such roads as are regularly rendered impassible by snowdrifts, and teams are obliged to use these temporary roads.

B. The Maintenance of the State Roads.

During the last century experiments have been made with the letting of the maintenance of the state roads to private parties, which experiments have, however, proved unsatisfactory. Then the Government took in hand the work of maintaining the state roads, and has adhered to this system up to the present day, with a short interruption in the years 1858–1861, during which time the keeping of the roads was again contracted for by way of experiment, which again gave but unsatisfactory results.

For the immediate carrying out of the work necessary for keeping in repair the state roads, road-keepers are employed by the Government, the number of which, according to the statement of 1872, was 3,625; consequently there was on an average one keeper for every 4.14 kilometres of state roads. Lately the number of road-keepers in Lower Austria and Salzburg has been reduced.

In larger districts road masters or inspectors are employed for conducting and superintending the work on the roads. The number of these inspectors in the year 1875 was 413, so that on an average there were 36.52 kilometres of road for every inspector to attend to.

a. METHOD OF MAINTAINING THE ROADS.

The maintenance of the Austrian state roads is carried on after the system of the so-called re-covering. After numerous experiments with other systems of keeping the roads, which have always failed, the above method has ever proved the best. According to this method the smaller defects of the road are continually repaired by the regular road-keepers, by removing the dust and mud from the ruts and hollows and filling them with gravel. It is then as a rule left to the passing wagons to pack these stones and roll them in. After certain longer periods of time, when the ballast of the roadbed has been thoroughly worn out, certain lengths of the road are again completely covered with ballast up to their normal height. This work is as much as possible carried out in wet weather, as a rule in the fall and spring of the year.

The rolling of the new layers of ballast, as formerly practiced, is now omitted. Experiments which have been made with rolling and with the so called patching system in the years 1856–1858, 1861–1864 and 1868 have neither financially nor technically given any satisfactory results. The reason for this may to a great extent be found in the circumstance that the most of the roads are not constructed in the manner of regular highways and were not provided with sufficiently thick layers of ballast.

b. CONSUMPTION OF BALLAST IN MAINTAINING THE ROADS, AND PROPORTION OF TRAFFIC.

Although the traffic upon the roads has not decreased since the building and development of the railways, but on the contrary has increased, the consumption of ballast (broken stones and gravel) upon the state roads has, since the year 1856, decreased continually. The average quantity of ballast per year and kilometre of state road amounted, in 1850–1856, to 93.3 cubic metres; in 1857–1864 to 70.7 cubic metres; and in 1865–1 872 to 62.4 cubic metres.

From the proceeds of the tolls collected upon the state roads, an average traffic of 200 vehicles per day may be calculated. From this there results as the specific consumption of ballast, *i. e.*, per kilometre of road, per year, and with a daily traffic of 100 vehicles, a quantity of 31.2 cubic metres of ballast, taking the average of the 7 years' period of 1865 to 1872. This quantity must be considered as very small in comparison with the ana logous requirements of other well-conducted countries.

In Lower Austria alone 180 cubic metres of ballast were used on an average per year and kilometre of state roads in the years 1850 to 1875; the maximum consumption was 285 cubic metres in the year 1853, and the minimum 130 cubic metres in the year 1863.

The average traffic on the roads of Lower Austria, however, is 800 vehicles per day. The average specific consumption of ballast therefore was 23.5 cubic metres.

In Bohemia, where excellent material for ballast is at disposition, the consumption of ballast, with an average traffic of 150 vehicles per day, amounted per kilometre and year, in the average of the years 1850–1875, only to 48 cubic metres, and in the year 1875 only to 40.4 cubic metres; consequently the specific co nsumption of ballast was 32 and 27 cubic metres, respectively.

c. THE CLEARING AWAY OF THE SNOW.

According to the regulations of the law, mentioned before (of Jan. 2, 1877), those communities (or estates), the territory of which is intersected by a state road,or which are not any further than 8 kilometres from such road, are obliged to cause the removal of the snow in so far as it is necessary for keeping up the traffic on such roads.

The Government, however, has the right to deviate from this rule and to cause the removal of the snow in any other manner.

The parties obliged to do this work receive a remuneration from the state road fund.

In those parts of roads, however, which are situated within a town, village, etc., as far as they form a passage through such town, etc., the respective town, etc., has to attend to without any remuneration.

C. The Passage Roads.

Of the costs of construction and maintenance of such parts of state roads as lead through towns, villages, etc., the state only pays the same amount as is required for the construction and maintenance of the continuation of the same roads outside of such towns, villages, etc. Therefore the removal of the mud scraped from such parts of roads and taken from the ditches thereof has to be attended to by the state road keepers.

When such parts of state roads forming a passage through towns, villages, etc., are paved throughout, the respective communities have to attend to the keeping of such roads. For this they receive a remuneration from the state road fund, but only in such proportion as if the road were a common highway (not paved).

D. Important Regulations of the Road Police.

All wagons built for a load of more than $2\frac{1}{4}$ tons must have wheels with rims of at least 11 centimetres width (Styria and Carinthia), and if they are built for more than $4\frac{1}{2}$ tons (in Styria), or more than $3\frac{1}{3}$ tons (in Carinthia) the rims of the wheels must be at least 16 centimetres wide.

In Lower Austria a width of wheel rim of 11.5 centimetres is prescribed for loaded wagons drawn by two or three horses, and in Bohemia the same for wagons drawn by two horses.

In going down hill the wheels must only be locked by means of brakes or drags (skid shoes), the latter of a minimum width of 18.4. The employment of chains for locking the wheels is not permitted.

If the road leads through woods, a clearance of at least 4 metres on either side of the ditch must be made.

The driving across the ditches, where there is no bridge or special crossing provided, or the driving on the blanquettes (borders) is forbidden, as well as the grazing of cattle on the latter.

E. Cost of Construction and Maintenance of State Roads.

During the period from 1828 to 1877 an average amount of 891,409 florins per year has been expended for the building and the more important reconstruction of state roads. The maximum costs, in the year 1874, amounted to 2,091,260 florins, and the minimum, in the year 1865, to 418,157 florins (since 1860). The maintenance of the gravel or broken-stone road surface, including the costs and transport of the stones, and the wages for workmen, etc., cost per kilometre of state road:

	Fl. kr.
In the year 1850	180.46
In the year 1869	167.88
In the year 1871	183.54
In the year 1873	207.02

The average cost for the period of 24 years from 1850 to 1873 may be calculated at 187 florins per year and kilometre of state road.

The amount of the total costs of maintenance, that is, for the road surface and for the other constructions appertaining to the roads, amounted from 1847 to 1873 to an average of 284 florins per year and kilometre.

In Lower Austria alone the expenses for the maintenance of state roads were 484 florins per kilometre in the year 1866, and in the years 1870–'73, on an average, 608 florins per year.

The average wages of the road-keepers and their assistants in the years 1868–1873 amounted to 43 florins 86 kreutzers per year and kilometre of road.

The average price of the ballast in the year 1873 was 2 florins 28 kreutzers per cubic metre.

In Bohemia the expenses for the maintenance of the road on the part of the state were as follows:

	Florins.
1877	1,239,197
1879	1,185,396
1881	1,074,920

Of these sums the expenses for the ballast alone were:

	Florins.
1877	639,706, or 52 per cent. of the total costs.
1879	586,464, or 50 per cent. of the total costs.
1881	526,521, or 49 per cent. of the total costs.

F. State Roads—Toll Receipts

In Austria the receipts of toll, collected upon the state roads in the average of the years 1860–1873, amounted to 2,618,549 florins net per year, with the maximum of 2,678,827 florins in 1861 and the minimum of 2,461,240 florins in 1873.

The net toll-receipts per kilometre of state road in the year 1873 was 172 florins 50 kreutzers.

In Lower Austria the annual net receipts for tolls increased from 554,612 florins in the year 1847 to 654,814 florins in 1873, in which latter year the annual receipts per kilometre of state road amounted to 944 florins.

In Bohemia these receipts increased in the above period from 478,217 florins to 553,002 florins in 1873.

The toll collected upon the state roads, the same as that for entering the city limits of Vienna, is:

	Kreutzers.
For a 2-horse vehicle	8
For a 1-horse vehicle	4
For one horse, not hitched	2
Per head of cattle	1

2. COMMON PUBLIC (NOT STATE) ROADS.

All other public streets and roads, which are not state roads, are subject to the independent administration of the single respective provinces, and with regard to them the respective provincial laws are in force. The most important of these laws are the following:

Province law for Lower Austria concerning the construction and maintenance of roads, not belonging to the state. (November 3, 1868. L. G. Bl. No. 17.)

Province law for Lower Austria of January 8, 1873, concerning certain alterations of the law before cited. (L. G. Bl. No. 5.)

Regulations of the road police for the public roads, not belonging to the state, in Lower Austria, excluding Vienna. (Law of October 24, 1868. L. G. Bl. No. 15.)

Province law for Upper Austria of December 11, 1869, concerning the building and maintenance of roads not belonging to the state. (L. G. Bl. No. 31.) The same for Moravia (L. G. Bl. No. 4, excluding 1869); Styria (L. G. Bl. No. 22, law of June 23, 1866); Carinthia (L. G. Bl. No. 15, law of July 25, 1864); Tyrol and Vorarlberg (law of February 21, 1870, L. G. Bl. No. 16).

A. Classification of the Public Roads.

The different provincial laws classify the respective roads generally into provincial roads, district roads, and community roads.

The following provinces classify their roads differently:

Carinthia, into provincial roads, subventioned roads, and community roads. Styria into district roads first class, district roads second class, and community roads. Bukowina and the coast district, into provincial roads, competition roads and community roads, etc.

Provincial roads are those roads which according to their importance have been declared as such by resolution of the diet; this refers in Lower Austria also to the district roads and in Styria to the first class district roads. District roads (second class in Styria) are those which have been appointed as such by the respective district authorities. All other roads (public) are community roads.

In Bohemia the total length of district roads in 1876 was 12,406 kilometres, and that of the community roads 4,675 kilometres; in 1881 these lengths were 13,492 kilometres and 4,894 kilometres, respectively; so that in the latter year there was an average of 0.260 kilometre of district roads and 0.094 kilometre of community roads per square kilometre of territory.

B. Construction of the Public Roads.

a. their transverse section.

The provincial and district roads of Lower Austria as well as the provincial roads of Upper Austria are constructed in the manner of

regular highways, with a width of 6 metres; the community roads, however (Lower Austria), are built according to the requirements of the local teaming, with a width of at least 4 metres, and the smallest roads with a width of 3 metres.

The provincial and competition roads (Tyrol, Dalmatia, coast district) also have a stone foundation and a width of at least 5 metres and at most 6 metres. In Bukowina the roads have a width of 8 metres. The provincial and subventioned roads of Carinthia are from 3.8 to 4.75 wide and in Salzburg the provincial roads are from 4 to 6 metres wide. In Bohemia (see Fig. 4 of the foregoing drawing) the provincial roads, must have a width of from 6.3 to 7.6 metres, and must have a stone foundation of 4.45 to 5.06 metres in breadth and 0.24 to 0.26 metre depth. The covering layer of ballast must be 0.1 to 0.13 metre, which is again to be covered by a layer of sand of 0.03 to 0.05 metre. Bottom width of the road ditch 0.47 metre, convexity of the road surface 0.13 to 0.16, with a width of road of 6.3 and 0.16 to 0.21 metre, with a width of road of 7.6 metre, *i. e.* 1 in 18 to 1 in 24.

For the district roads in Bohemia the following measurements are prescribed: Width of road surface, 5.7 to 6.7, or 3.8 to 4.75 metres; depth of stone foundation, 0.16 to 0.24 metre; covering of ballast, 0.8 to 0.10 metre; top layer of sand, 0.026; convexity, 1 in 21 to 1 in 27; bottom width of ditch, 0.40.

In districts where the stone for the foundation layer would be too expensive to get the road may be macadamized. In such cases the ballast must be put on in layers and rolled until it has reached a thickness of 0.26 to 0.32 metre with provincial roads and 0.21 to 0.26 with district roads. The road must in such cases be provided with bordering stones on either side, in order to prevent the ballast from leaving the road when being rolled.

Provincial and district roads are to be planted with trees in distances of from 20 to 25 metres (Lower Austria, Carniola, Carinthia). In Moravia, if possible, fruit trees must be planted along the roads in distances of 10 metres apart and 0.15 metre distant from the outside border of the road; otherwise these trees are to be planted on the adjoining ground at a distance of 0.60 or at the most 0.65 metre from the outside border of the ditch.

b. Gradient of the Roads.

The gradient of provincial roads (in Bohemia) as a rule must not be any more than $\frac{1}{18}$, and only with very unfavorable territory it may be as much as $\frac{1}{16}$. Steeper gradients are permitted as an exception only on mountain roads, and there only in lengths of at most 95 metres, when these ascents are interrupted by stretches of horizontal or nearly horizontal road.

The district roads of Bohemia are not to have a gradient of more than $\frac{1}{16}$, and with very unfavorable territory not more than $\frac{1}{12}$; steeper ascents are only allowed as an exception on roads for less heavy teaming than the usual, and only by special permission of the board.

c. Maintenance of the Public Roads.

The respective regulations for Lower Austria, to which those of the other provinces are similar, are the following:

The building as well as the maintenance of the provincial roads is incumbent upon the provincial committee, and with district roads to the respective district road board or committee. The proceedings of the latter however are supervised by the provincial committee.

The different communities are obliged to attend to the building and the maintenance of the respective district roads under the supervision of the board or committee for district roads.

If the ballast necessary for the maintenance of the district roads can not be obtained by way of public proposal, or only at a very high price, the commmittee for district roads has the right to charge the communities with the furnishing of such ballast at a price to be fixed according to circumstances. The costs for carting away the dirt removed from the roads are paid by the district treasury; the communities, however, are obliged to furnish free of cost the dumping places and roads leading thereto. These places must not be farther than 1 kilometre from the respective parts of the road.

The removal of the snow from the roads has to be attended to by the communities, the territory of which is not more than 8 kilometres distant from the road. For this work they receive a proportionate remuneration.

d. Costs.

All costs for the building and maintenance of provincial roads (in Styria) of first-class district roads are paid from the provincial fund.

The costs for the district roads, in so far as they are not otherwise covered, fall to the respective districts, which as a rule are identical with the court districts. The raising of the necessary money is prescribed to the different communities of the district in proportion to their direct taxes (with exclusion of the extraordinary addition tax). A levy of more than 10 per cent. and up to 15 per cent. of the total tax amount requires the permission of the provincial committee, and such of over 15 per cent. can only be imposed by way of legislation. According to circumstances subventions from the provincial fund may be granted for the building, reconstruction, and even maintenance of district roads.

The necessary means and work for community roads have to be furnished by the respective communities. For important community roads, however, subventions from the district road fund are permissible.

The construction of the roadway of a district road with 4.8 millimetres ballasted surface, a stone foundation of 0.20 millimetre, and a bed of ballast of 0.14 costs per kilometre about 3,800 florins, not including the value of the ground and the ground work nor the costs of supervision.

Buildings erected along provincial, district, and community roads

must stand at least 2 metres away from the outside border of the road ditch in Upper Austria, Bohemia, and Carniola; while in Moravia, Silesia, and Lower Austria this distance must be at least 4.7 metres.

For public houses (inns) this distance must be 4 metres in Upper Austria.

STREETS.

The essential rules for the construction of streets in cities and towns are contained in the different building regulations (Bauordnungen; B. O.).

Lower Austria, B. O. for Lower Austria and for the city of Vienna (laws of January 17, 1883, L. G. Bl. 12).

Upper Austria, building laws of March 13, 1875 (L. G. Bl. 7, 8).

Salzburg, B. O. for the city of Salzburg of January 28, 1873 (L. G. Bl. 9).

For the province of Salzburg, excluding the capital, B. O. of July 7, 1879 (L. G. Bl. 10).

Styria, B. O. for Styria, exclusive of the city of Graz, of February 9, 1857 (L. G. Bl. 5); alterations of this law, of August 31, 1864 (L. G. Bl. 2); B. O. for Graz of September 7, 1881 (L. G. Bl. 14, etc.).

A. Construction of city streets and regulations relating thereto.

New streets, if they are principal streets, must be at least 15 metres wide (Lower Austria, Upper Austria, Styria, Carinthia, Moravia, etc.); side streets and lanes must be at least 11 metres wide in Lower and Upper Austria, and at least 12 metres in Prague.

Besides a roadway sufficiently wide to permit the easy turning around of wagons, new streets must be provided on either side with a sidewalk, including which their entire breadth must be at least 15 metres (Graz).

In Vorarlberg the streets in cities and towns must be at least 12 metres wide, in country communities at least 9.5 meters, and lanes at least 8 metres.

In Linz, Wels, Steyer the streets to be considered as principal must be at least 16.20 metres wide, less frequented streets at least 14 metres, and side or cross streets or lanes at least 12 metres.

a. STREETS OF VIENNA.

The total square surface of all streets, lanes, and squares (including the sidewalks, walks, and riding paths) maintained by the imperial city of Vienna at the end of the year 1888 amounted to 5,075,596 square metres. Of these the roadways, squares, crossings, etc., occupy 3,663,740 square metres, or 72.2 per cent., and the sidewalks, walks, and riding paths 1,411,856 square metres, or 27.8 per cent.

Of the entire street surface 3,121,294 square metres, or 61.5 per cent., are paved. Of this paved surface 2,055,181 square metres, or 65.8 per cent., belong to the roadways, squares, crossings, etc., and 1,066,113 square metres, or 34.2 per cent., to the paved sidewalks.

Comparing with the measurement at the end of the year 1887 the paved surface at the end of the year 1888 showed an increase of 55,618 square metres, or 1.81 per cent.

At the end of 1888 the different kinds of pavement in use were in the following proportions:

	Square metres.
Roadways, squares, etc.	
Granite	1,827,276
Asphalt	49,027
Wood pavement	11,030
Gutters and street crossings, granite	167,848
Sidewalks and walks:	
Granite	1,033,275
Asphalt	28,703
Clinker	4,135
Total surface paved	3,121,294

Consequently the entire pavement was composed of:

	Per cent.
Granite	97.03
Asphalt	2.48
Clinker	0.13
Wood	0.36

Of the unpaved surface of 1,964,302 square metres, which are partly macadamized, partly only covered with ballast, 1,608,559 square metres, or 82 per cent., belong to roadways, squares, etc., and 345,743 square metres, or 18 per cent., to walks and riding paths.

Besides the paved surface enumerated there are still of streets, lanes, and squares within the territory of Vienna,

Maintained by—	Paved.	Unpaved.
	Sq. metres.	*Sq. metres.*
The government	49,446	24,372
The provincial fund	72,747	36,361
Private persons	3,200	161,216

Including the above figures the total surface of streets, squares, etc., of Vienna at the end of the year 1888 consequently was: Paved, 3,246,687 square metres, and 2,176,251 square metres unpaved. This total service comprises 1,008 streets, lanes, and squares.

The granite cubes employed for paving the Vienna streets, as a rule, have a length of side of 18.4 centimetres. For the diagonal paving of the roadways there are besides required stones of 13.2 and 23.7 centimetres. Finally, there are also smaller cubes of but 15.8 centimetres side; these, however, are used only in small quantities.

The paving is generally carried out diagonally, and only for streets with a very steep gradient parallel rows are employed.

For the paving of the sidewalks mostly granite plates of 31.6 centimetres and 47.4 centimetres squares are employed.

The greatest part of the granite for paving the streets of Vienna is taken from the quarries at Mauthausen, in Upper Austria. For paving those streets, however, which have an exceptionally great traffic, the hard granite of Wilshofen, in Bavaria, as well as that from Schärding and Dornach, in Upper Austria, are employed.

The clinker pavement, formerly employed by way of experiment on the roadways, has been removed again on account of its inferior durability.

For the asphalt pavement (of natural asphalt) the roadways are covered with pressed asphalt, while on the sidewalks the asphalt is poured over a layer of sand.

By way of experiment the so-called metallic pavement has been tried upon a larger surface. For this purpose a bed of concrete of 10 centimetres is employed, upon which is spread the "metallic" composition 6 centimetres thick for the roadway.

The metallic pavement (furnished by the firm C. Schlimp & R. Scheftel) is a kind of concrete, and consists of broken blast-furnace slag, cinders, and Portland cement; to the water required for mixing this concrete carbouate of soda, carbonate of ammonia, or crude potash is added.

The metallic pavement, the same as asphalt and wood pavement, is noiseless.

B. Maintenance of City Streets.

As most worthy of interest, the facts furnished by the city of Vienna regarding the maintenance of streets will here be given.

The work of maintenance of the Vienna streets as a rule consists in their being repaved, which is done by tearing up the pavement to be repaired and by freshly paving those parts of the street, making use, however, of part of the old material.

The following dates will show the extent of repaving in Vienna:

Year.	Roadway.	Sidewalks.	Total.
	Sq. metres.	*Sq. metres.*	*Sq. metres.*
1884	64,689	16,659	81,348
1885	57,165	10,393	67,558
1886	37,103	8,454	56,557
1888	38,755	7,100	45,955
Five years' average	48,827	10,551	59,378

The ballast used for the maintenance of the respective streets and squares was as follows, in cubic metres, per year:

Time.	Kinds of ballast.							
	Mountain.		Ordinary gravel.	Coarse gravel.	Fine gravel.	Vienna river sand	Sand.	Total.
	Broken.	Gravel.						
Five years' average, 1884–'88	14.952	8,156	5,612	1,122	625	1,505	2,044	34,016
In 1888	13,216	8,222	7,897	977	594	1,456	3,236	35,598

Leaving out the sand, the actual ballast used was 34,972 cubic metres in the average and 32,362 in 1888.

Supposing this total amount of ballast equally divided upon the surface of unpaved roadways, squares, etc., the annual consumption of ballast per square metre of street surface amounts to 0.02 cubic metre.

C. Costs of Construction and Maintenance of City Streets.

The following were the average costs, per square meter, for new paving in the year 1888:

	Florins.
With Vilshofen granite stones	7.70
With Mauthausen granite stones	7.02
With old granite stones	1.06
With common stones	2.81
With asphalt	6.08
With wood	7.44

For the repaving of a surface of 38,755 square metres of roadway and of 7,100 square metres of sidewalks 41,563 florins 78 kreutzers were expended in the year 1888, which is equivalent to an average of 0.91 florin per square metre.

The total expenditure of the city of Vienna for building and maintaining the streets amounted to the following:

Year.	New construction.		Maintenance.	
	Paved streets.	Unpaved streets.	Paved streets.	Unpaved streets.
	Florins.	*Florins.*	*Florins.*	*Florins.*
1887	499,710	282	272,438	119,738
1888	408,891	3,760	133,769	130,349
Five-year average, 1884–1888	392,287	26,079	255,170	118,566

The cleaning and sprinkling of the streets in the year 1888 cost for the first district (the central part of the city) 375,928 florins, and for the entire territory of Vienna 908,008 florins.

The total surface of the streets, lanes, and squares kept by the city of Vienna amounting to 5,075,596 square metres, the cleaning and sprinkling of one square metre per year costs 17.9 kreutzer.

D.—Public Parks and Gardens of Vienna.

The following table shows the number, extent, and cost of maintenance of the public parks and gardens of Vienna:

Year.	Number.	Surface.	Cost of maintenance.
		Square metres.	*Florins.*
1887	34	381,473	111,148
1888	35	387,383	123,951

These public gardens (in 1888) amounted to 0.7 per cent., and if the woods are included to 16.7 per cent. of the entire precinct of Vienna, which is 5,540 hectares.

CONCLUSION.

Public streets and roads are universally acknowledged as the prime means of culture, and it is a fact proved by history that the grade of civilization of a nation may in a great measure be judged by the state of its public roads. There is no doubt that the land value is in every country considerably improved by well kept and frequented public roads. It is, however, impossible to express in figures or fix the extent of improvement in value of land intersected by public roads, as this is most everywhere depending on local conditions and circumstances.

JULIUS GOLDSCHMIDT,
Consul-General.

UNITED STATES CONSULATE,
Vienna, April 1, 1891.

TRIESTE.

REPORT BY CONSUL HARTIGAN.

The streets of Trieste, except a few macadamized ones, are paved with sandstone obtained from the neighboring mountains (Karst). This sandstone costs the corporation 2.70 florins per square metre ($1.13 per square yard). The average price of macadamizing stone is 1.45 florins per cubic metre, or 61 cents per cubic yard.

The expense of laying the sandstone, not including its cost, sand, or cartage, is 1 florin per square metre (42 cents a square yard). The labor for macadamized streets costs 80 kreutzers a square metre, or 34 cents a square yard, except the gutter flagging, which costs in addition, 3.25 florins per linear metre, ($1.37 per linear yard).

The maintaining of macadamized roads costs very little. Their average depth is 6 to 10 inches, and the nature of the soil is such that it requires little preparation for a foundation. The maintaining of the paved streets is according to the traffic; the average price, including labor and material, is 50 cents a square yard.

In laying new pavements the old one is placed underneath with a layer of sand intervening, the entire cost of which is 5 florins per square metre ($2.10 per square yard). New streets without this under pavement cost 4 florins per square metre, or $1.78 per square yard, including stone, sand, cartage, etc.

Formerly the streets were laid concave inclining to the middle, along which under the surface canals or sewers extended, with gratings at intervals for surface drainage. It was found, however, from experience

that this plan was not durable for heavy traffic. Accordingly, when new pavements are now found necessary the convex method is adopted. The water from the gutter is conducted by branches to the middle canals or sewers. These latter are also receptacles for overflow pipes from the fecal vaults of the various houses, there being no other sewerage system in the city. The contents are finally emptied along the river or quays of the town.

The streets in general are intended for heavy traffic. The sidewalks are of the same stone, the flags being about 1 to 4 inches thick and 2 to 4 feet square. Their construction and maintenance are borne by the property owners, as well as the stone pillars which line and separate them from the street.

The Trieste sandstone is resisting and desirable material for street paving; the pieces are from 2 to 5 feet long, 1 to 1½ feet wide, and 6 to 10 inches thick.

The roads outside the city are macadamized of the same average depth, and have a stone foundation with open drains on either side.

JAMES F. HARTIGAN,
Consul.

UNITED STATES CONSULATE,
Trieste, January 30, 1891.

BELGIUM.

PROVINCE OF ANTWERP.

REPORT BY CONSUL STEUART.

I have the honor to offer the following report upon the manner of constructing and maintaining the roads and streets in this province and city of Antwerp, and as the said roads and streets are well made and well kept, it would be gratifying if a consideration of the careful manner in which the work is contracted for, executed, and kept in repair should prove of service to those interested in bringing about an improvement in the manner and expense of doing these things in our own country.

The thoroughfares in the Kingdom of Belgium are: The routes running from one part of the Kingdom to another controlled and managed by the state authorities; the provincial chaussées, or roads, between two points within a province, constructed and controlled by the provincial authorities; these are paved in the center, a dirt road on each side, and are bordered with trees; the streets constructed and controlled by the municipal authorities.

The provincial council of the province of Antwerp is composed of some sixty members elected from different parts of the province. They

hold one session each year, in the month of July, presided over by the governor of the province, for the purpose of passing the budget, voting subsidies, ordering and approving the construction of roads, canals, etc., and such other matters as may come before them. During the remainder of the year when they are not in session, a committee of their body, consisting of five members, called the "Deputation Permanente," is always in organization, clothed with full powers and prepared to carry into execution the orders and instructions passed by the council, a report being made by them at the next meeting of the council for approval and ratification. Their duties and powers are referred to in the body of the contracts given further on.

Under the rules of the technical service of the province of Antwerp, the service of roadways is intrusted to a body of provincial agents, composed of one engineer-in-chief, three district engineers, and inspectors of roads to a number not exceeding 60.

These agents are charged (in the limits presented by the present rules and in accord with the authorities designated in the legal rules upon the matter) with the service of the district roads, of the works of hygiene, and of the water courses not navigable.

The rules and regulations governing this body of agents are full and elaborate, much too numerous to be translated and embodied in this report, so they are sent in pamphlet form under separate cover.

The streets in the city are all built of the same material and without reference to the traffic that passes over them, whether light or heavy. An idea of their cost can be had from the estimate of expenses making part of the contract for building a street as given below.

As regards the assessment for first cost and maintenance, I can only refer to my dispatch No. 255, dated June 28, 1887, forwarding a full report upon taxation, national and local, in this district, in which occurs the following remarks upon the municipal tax upon sewers and pavements:

> The payment of this tax is required but once, and not yearly, even not again when repairs become necessary and are made.
>
> In 1852 the rate was fixed at 12 francs per running metre for all expenses connected with the building of a sewer, and was collected upon the buildings immediately, while owners of unimproved property paid only when they erected buildings thereon; also a tax of 8 francs per metre was collected from buildings upon new pavements, or 5 francs upon old ones, owners of unimproved property paying 2 francs at the time, and the balance when buildings were erected. This law is still in force regarding the property covered by it at that time.
>
> In 1874 the law was changed as follows: For the expense of sewers 12 francs per running metre is collected from the proprietors of improved and unimproved property, and for pavements 10 francs is collected upon the same measurement.
>
> In the laying out of new streets the owners of the property fronting on said streets will be required to bear all the expenses, each in proportion to the number of running metres along the front of his property.
>
> The amount due per metre is found in dividing the cost of the work by double the length of the street, thus covering both sides.
>
> Every six months a map is drawn up for the purpose of showing what new buildings have been erected since the last verification.

Under separate cover and forming part of this report I forward for reference the following documents,* viz:

No. 1. Rules governing the technical service of the province of Antwerp, November 12, 1886.

No. 2. Contract and conditions for the maintenance in good order for a period of five years of the provincial roads of the province of Antwerp.

No. 3. Contract and conditions for the maintenance in good order, for a term of 3 years, of the routes of the state passing through the province of Antwerp.

No. 4. General statement of the conditions governing the work and furnishing of material under the service of the municipal authorities of the city of Antwerp.

No. 5. Contract and conditions for the construction of a chaussée in the district of "Waerloos" in the province of Antwerp.

No. 6. Contract and conditions for the paving and sewerage of the "Rue du Dauphin," in the city of Antwerp.

The two last-named documents have been translated and given below; they furnish the details of the system followed and an estimate of the expenses attendant thereupon.

JOHN H. STEUART,
Consul.

UNITED STATES CONSULATE,
Antwerp, February 2, 1891.

CITY STREETS.

MUNICIPAL WORKS OF ANTWERP.

[Inclosure 1 in Consul Steuart's report.]

Estimates and conditions for the execution of the street works in the Rue du Dauphin (eastern district), Antwerp.

ARTICLE 1.

The object of the present undertaking is the execution by contract of the sewers and pavement of the above-mentioned street, also a water connection with the canal Herenthals.

The work in general shall be executed in accordance with the indications of the plan annexed to the present conditions and with the instructions contained therein. The contractor, in addition, will, in the execution of the works, be held to follow the instructions of the directors.

All the terms and conditions of the general statement of conditions, registered and filed in the fourth bureau, at the City Hall, are deemed to be textually given here, in so far as they are not modified by the following articles:

ARTICLE 2.

The works to be executed consist of:

1. The execution of the works of digging out and filling in, also the leveling, comprising the furnishing of the earth and the work that may be required to brrng same to the prescribed height, and to form the side banks, destined to strengthen the sidewalks; the demolition of the sewers indicated on the plan.

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* Not published.

2. The construction of an ovoid sewer of 14 water pipes with collars for outlets of 14 cast-iron gratings, with ventilators, of the required model and of 11 masoned means of access with cast-iron brinks, comprising the fixtures necessary for draining.

3. The construction of two sections of sewer, paved with flags, in the "longue and courte rue de l'Autel."

4. The work of paving with new stones and the employment in the part of the street destined to vehicles, of new extra large stones (coulants) near the curbs.

5. The work of paving with new stones and the employment for the sidewalks of new borders of cut stone, comprising the joining of the paving in the street and on the sidewalks.

6. The construction of a water connection with the canal Herenthals.

ARTICLE 3.

The guiding mark for the leveling forms the tablet of the bridge of the "rue du Canal." This point is situated at a slope of 5.95 metres.

ARTICLE 4.

The side banks, which shall strengthen the sidewalks, will be executed along the entire length of the street to be paved, conform to the conditions prescribed, and at the expense of the contractor. This work shall be executed with the earth excavated from other places. These banks will be turfed to a width of 25 centimetres, conform to the instructions of the directors.

ARTICLE 5.

The sewer, the stone water pipes, the means of access, and the water connection shall be executed according to the indications of the plan hereto annexed, the prescriptions of the conditions, and the special indications of the directors of the work.

ARTICLE 6.

The sewer to be constructed shall have an interior height of 1.30 metres and a width of at most 80 centimetres. Its length shall be 385.70 metres and its frame shall be established at the sides, as shown in the plan.

ARTICLE 7.

The concave and convex parts of the sewer shall be formed by two rolls of one-half brick "klampsteen" (ordinary brick) of the kind known by the denomination of "klinkært."

The sewer shall be rough-cast in the interior, up to the commencement of the superior arch, with hydraulic mortar, and the dome of the arch, with the addition of two parts cement.

The centerings shall be properly constructed and strengthened with planks of 2 centimetres thickness; the entire convex surface shall be established in a manner to present a regular curve.

The supports of the centerings shall be placed at a distance of 70 centimetres from axis to axis.

The extrados of the superior arch shall be covered with 1 centimetre's thickness of hydraulic or common mortar.

ARTICLE 8.

In the arch shall be established eleven openings, each surmounted by a means of access, having walls of 19 centimetres thickness and an interior diameter of 80 and 70 centimetres. The means of access shall be crowned with a cast-iron brink to conform to the model deposited at the storehouse Leguit.

The contractor shall furnish and place ninety-two collars of cut stone for the outlets of public and private water pipes.

The junction of the sewer to be constructed to that of the Rue du Dragon shall be established in conformance with indications from the directors.

ARTICLE 9.

The masonry shall be executed with hydraulic or common mortar. The mortar shall be made under the supervision of an agent of the administration and in a covered place. The mixture of raw materials shall be made in a dry state, then put into a crusher, with the addition of the necessary water.

The directors reserve the right to prescribe the time at which the mixture shall be worked in the crusher.

ARTICLE 10.

The contractor shall transport to the storehouse in the Rue St. Gom maire the stones or flags accruing from the demolition of the sewers referred to.

ARTICLE 11.

The curbstones, as also the crest of the pavement of the part of the street destined to vehicles, shall be established at the level designated in the plan.

ARTICLE 12.

The new sidewalks shall be 2.04 metres wide and the carriage route 7.92 metres. The slope of the sidewalks shall be 8 centimetres.

ARTICLE 13.

The paving stones for the street and the stones used for the curbs shall be procured from one of the quarries enumerated under the first category in the conditions. They shall be strictly refused by the administration in case the cutting of the tops is not perfect or does not conform to the prescriptions of the last paragraph of article 28 of the conditions.

The paving stone of the 4th sample shall solely be admitted for the vehicle route, excluding all others. The curbstones shall be procured at the quarries of Quenast or those of Sweden.

Paving stones 6 by 4 (boutisses) shall be placed alternately at the end of the lines.

The paving stones for the sidewalks shall be procured from the quarries of Dinant, of Yvoir, or from the Ourthe, excepting, however, those of Marche and Gernelle; they shall be taken from the best beds and shall be of a uniform blue gray. The dimensions of these stones shall be 14 by 14 centimetres at the top and 10 to 12 centimetres at the bottom, and the height 8 to 11 centimetres. The stones shall have flat tops, even and perfectly smooth, the sides well squared and edged. The paving stones are generally chosen at the expense of the city.

ARTICLE 14.

The straight new curbstones shall have a width of 17 centimetres and a height of 30 centimetres; they shall be placed according to the profile indicated in the plan, and each stone must have a length of at least 1½ metres. They shall be procured from the quarries of Ecaussines, Soignies, or Féler.

The curved borders to be furnished and placed number three, of 2 metres and three of 4 metres, radius. The first mentioned shall be composed each of two pieces, 1.20 metres in length, and the others of seven pieces of 1.25 metres in length.

The curved borders shall be 30 centimetres high and 17 centimetres wide at the junctions, and shall have the same profile as the straight borders.

The curved borders shall consist of Swedish or Quenast porphyry.

The joints of the borders, in general, shall be strengthened with mortar.

ARTICLE 15.

In the water way shall be established fourteen sewer gratings, with cast-iron ventilator, similar to the model deposited at the storehouse Leguit.

ARTICLE 16.

The contractor shall take the measures necessary in order to preserve all the pipes serving for the distribution of water and other purposes. In case of an accident, he shall advise the grantee society, who will repair the damage done. The expense arising therefrom will be paid by the city and deducted from the amount retained as guaranty from the contractor.

ARTICLE 17.

The work must be entirely completed within a period of 2½ months.

ARTICLE 18.

The expenses of the undertaking shall be met in three payments.

ARTICLE 19.

The amount of the guaranty to be deposited with the municipal collector is fixed at 2,000 francs.

ARTICLE 20.

The expenses for stamps and registering must be paid into the 4th bureau of the city hall of Antwerp within 8 days after the acceptance of the offer.

ARTICLE 21.

The contractor shall include in the price of his offer a sum of 2,085 francs to cover expenses for watching, plans, and others, which will be deducted from the amount of his offer.

ARTICLE 22.

The envelope containing the offer should bear, under the address of the burgomaster, the words: "Offer for the execution of street works in the rue du Dauphin."

Prepared by the undersigned, engineer of municipal works.

Antwerp, ——— 18—.

(Signed) ——— ———

Seen and presented, Antwerp, ———, 18—.

Engineer and chief director of municipal works:

(Signed) ——— ———

Approved by the "Collège des Bourgmestre et Échevins" of the city of Antwerp, in their sitting of ——— —— 18—.

The burgomaster:

(Signed) ——— ———

The secretary:

(Signed:) ——— ———

Detailed estimate.

Description of works.	Quantity.	Price per unit.	Total amount.
		Francs.	*Francs.*
Excavation, shoving up of earth accruing therefrom, eventual draining, reëmployment of the earth for filling in and damming, comprising the demolition of the sewers designated in the plan, cu. metres..	1,404	1.10	1,544.40
Furnishing and working of the earth in order to bring the street to the required height, comprising leveling and damming..cu. metres..	3,533	.30	1,059.90
Sewer, 1.30 by 0.80 metres.....metres..	385.70	15.00	5,785.50
Sewer, 0.70 by 0.50 metre .....do ...	20	12.00	240.00
Means of access .....cubic metres..	5.500	22.00	121.00
Furnishing and placing of trap doors.....kilos..	2,100	.16	336.00
Stone water pipes of 20 centimetres interior diameter .....metres..	63	5.00	315.00
Sewer gratings with cast-iron ventilator.....	14	75.00	1,050.00
Rough casting with cement mortar of the interior of sewer to 1 centimetre thickness.....	826	1.00	826.00
Cut stone for outlets of public and private branchings off; 92 x 0.45 x 0.45 x 6.30 cubic metres	5.575	120.00	669.00
New straight curb stones.....metres..	550	6.00	3,300.00
New curved curb stones.....do....	27.10	13.00	352.30
Pavement with new stone 8 by 4 for sides .....square metres..	92.32	13.00	1,200.16
Pavement with new stone for street.....do....	2,431	7.00	17,017.00
Pavement with new stone for sidewalk.....do....	1,079	6.00	6,474.00
Old curbstones, taking up and placing.....metres..	10	.30	3.00
Pavement with used stones for sides..... square metres..	1.60	.80	1.28
Pavement with used stones for sidewalks.....do....	20	.80	16.00
Pavement with used stones for streets.....do....	150	.35	52.00
Transportation of flagstones to storehouse of the city.....	.....	.....	75.00
Establishment of the water connection with the canal Herenthals:			
Foundations in rough masonry .....cubic metres..	1.650	12.00	19.80
Masonry.....do....	13	22.00	286.00
Furnishing and placing of cut stone.....do ...	2.027	120.00	243.24
Wrought iron for grating of the 2 mouths of the water connection comprising sealing with lead.....kilometres..	40	.40	16.00
Cast-iron trap doors of 80 by 80 centimetres.....do....	450	.16	72.00
Expenses for guards, plans, etc	.....	.....	2,085.00
Expenses for stamps and registering	.....	.....	24.92
Total.....	.....	.....	43,185.00

Drawn up, with an estimate of the sum of 43,185 francs, by the undersigned engineer of the municipal works.

Antwerp, —— ——, 18—.

(Signed,) —— ——.

Seen and approved, Antwerp, —— ——, 18—.

Principal engineer, director of municipal works:

(Signed,) —— ——.

MODEL OF OFFER.

I, the undersigned (full name), contractor of public works, residing at ——, street ——, No. ——, bind myself by the present, upon guaranty of my personal and real property, to execute under the terms and provisions of the contract and special conditions, according to the prescriptions specified and conforming to the plan, of which I declare to have a perfect knowledge, in consideration of the sum of (to be written out in letters), the street works in the Rue du Dauphin.

Done at ——, the —— day of ——, 18—.

COUNTRY ROADS OR HIGHWAYS.

[Inclosure 2 in Consul Steuart's report.]

PROVINCIAL GOVERNMENT OF ANTWERP.—TECHNICAL SERVICE.

Statement of the stipulations and conditions upon which will be awarded the construction of a chaussée or wide carriage road following the route No. 3 at Waerloos.

DESCRIPTION OF THE WORK.

ARTICLE 1.

The undertaking comprises:

1. The execution of the earthworks.
2. The construction of the "ouvrages d'art" and the furnishing of the necessary material.
3. The paving.
4. The maintenance in good order for 1 year of the chaussée and its dependencies.

ARTICLE 2.

The road to be constructed shall be laid out according to the trace in red upon the plan annexed to the present contract and conditions; it will commence at a given point in the village of Waerloos; will extend along the road No. 3 to join the direct chaussée from Waerloos to Duffel near the limits of the latter village. The total length of the chaussée is to be 1,917.50 metres.

ARTICLE 3.

The red line running lengthwise along the plan of the chaussée shows the height at which will be established the crest of the paving.

The system of slopes and borders shall be made conformably to the indications of the profile lengthways.

The slopes and borders shall be joined to each other in the vertical sense by regular curves of which the development will be indicated by the provincial engineer.

The route shall have 6 metres of width between the outside crusts of the sideways; the paved part will occupy the middle part of the route and will have 2.50 metres of width.

The convexity of the paving shall be 97 centimeters, and the transverse inclination of the sideways shall be .04 centimetre per metre.

The route shall be bordered with ditches having 1 metre width at the top and 40 centimetres depth. These dimensions may be modified according to the requirements of the ground.

The crests of the sideways shall be marked by level borders of grass of 25 centimetres width with 8 to 10 centimetres thickness.

ARTICLE 4.

The plan of the work shall be executed by the contractor or his agents under his responsibility. The work, however, can not be commenced until after the plan has been verified by the provincial engineer.

All the tools, utensils, engines, wheelbarrows, carts, etc., in fact all the material necessary for the carrying on of the work, without any exception whatever, must be provided by the contractor.

The works will be commenced at the points designated by the provincial engineer.

ARTICLE 5.

The earth coming from the excavation and that necessary for the embankments shall be employed to form the profiles of the roads following the sides; the same earth shall serve to unite roads, avenues to farms, or entrances to fields with the sideways of the route.

The earth removed, with the exception of mud, roots, and grass shall be employed in the work of filling up and embanking.

If the ground coming from the excavations is not sufficient to meet the requirements of the embankments the contractor must provide the quantity needed.

ARTICLE 6.

After all the preliminary earthworks have been finished a coffer shall be opened at a depth of 25 centimeters, preserving at the bottom a slope or convexity equal to that of the paving. The bottom as well as the sideways shall be made thoroughly strong.

The bed of sand will have a thickness of 25 centimetres, measuring from the top of the pavement.

ARTICLE 7.

Paving.

The borders shall be placed along the line following the slopes, declivities, and levels as indicated. They shall be joined and made firm at the outside with sand well driven in.

The space between the two border lines shall be filled with paving stones forming a regular connection, placed in such a manner as to touch each other on all sides, the joints well filled with sand and made firm under the weight of a hammer of at least 6 kilogrammes.

The stones shall be successively driven firm with a paving beetle weighing at least 16 to 18 kilogrammes.

The hammering shall commence at the borders of the chaussée and be continued towards the axis, taking care to preserve the slopes and convexity indicated upon the plan.

The hammering shall be done regularly by two workmen, commencing one from each side of the route and advancing towards the axis, hammering the same line of stone.

All the stones which may be broken under the weight of the beetle, or which may be driven below the surface line, shall be removed and replaced by others having the proper dimensions to be fitted to those already placed.

When the supervisor of the works shall be satisfied that the paving has been well done, there shall be spread upon it a bed of sand 2 centimeters deep.

ARTICLE 8.

The operations of the plan and the verification of the work shall be at the charge of the contractor, who will furnish for this purpose the workmen and the instruments necessary, such as squares, levels, chains, lines, stakes, etc.

ARTICLE 9.

Travaure d'Art.

The framework of the "Travaure d'Art" shall be made firm to the sides of the level marked in the special plans.

These works of art shall be constructed under the best conditions conformably to the plans, and after the indications of the provincial engineer.

These works are:

One aqueduct with 80 centimetres opening, square section, and covered with flagstones.

Three aqueducts of 30 to 35 centimetres opening, section rectangular, and covered with flagstones.

Article 10.

The compensation due to third parties for the taking of sand, earth, depots of materials, shops, service roads, etc., will be at the charge of the contractor.

In no case will a depot of materials be allowed upon the ground reserved for the bed of the route or its dependencies.

Article 11.

Materials.

The paving stones shall be in porphyry or sandstone.

The contractors must indicate in their offer the kind (porphyry or sandstone) and the place of production of the paving stones that they agree to place in the work.

The administration reserves the right to choose, as best suits them, among the different offers.

The paving stones shall have the following dimensions: Length, 14 to 16 centimetres; width, 14 centimetres; height, 14 centimetres at the least.

The borders of the chaussées shall be in ordinary limestone granite. They shall have the following dimensions: Length, 26 to 36 centimetres; width, 14 centimetres; height, 25 centimetres.

Sand: The sand shall be pure, dry, gritty, free from stones and clay.

Lime: The lime shall be of the best quality, and shall be furnished "quick" at the foot of the work.

Bricks: The bricks shall be of the kind called "Klampsteen." They must be well formed, well burnt, hard, and sonorous. The bricks for the facing shall be chosen from among the best looking and the best burnt. They shall be of uniform color.

Bluestone: The bluestone shall be of the ordinary limestone granite. It shall be taken from the largest and hardest quarries. It shall have neither flaws, thin places, broken corners, or defective veins.

The facings shall be finely cut. The tablets shall be provided with drains.

Flagstones: The flagstones shall be of stone from "Tournai." They shall be of best quality and have a uniform thickness.

Mortar: The mortar of the ordinary masonry shall be composed of two parts of slack lime, one part of ashes, and one part of sand.

That for the rough casting of the "Ouvrages d'Art" shall contain three parts of lime and two parts of "trass," which is a rough cement.

Article 12.

Nature and reception of material.

All of the material, each of its kind, shall be of the best quality; it must be delivered at the works, but can be employed only after having been accepted by the administration. It must be placed in such a manner that its verification may be as easy as possible.

The contractor must furnish the workmen necessary for the reception of the material.

The material rejected must be immediately removed from the works and replaced by others, and that before the resumption of work.

ARTICLE 13.

General conditions.

The present enterprise constitutes an absolute contract, consequently the contractor shall be held for in consideration of the price of adjudication, to execute, at his expense, risk, and peril, and to deliver, at the expiration of the contract time, all the works which make the subject of this contract and which are mentioned or described in the present conditions or appear upon the plans hereto annexed, in furnishing and putting upon the work all the materials necessary to this effect and in conformity with all the clauses and provisos stipulated in the said conditions.

The contractor shall be considered to have established the sum total of his offer after his proper calculations and estimates; he will not be permitted to raise any claim by reason of errors or omissions which might appear in the measurement and detailed estimates, which are joined to the conditions only as simple suggestions, and of which the quantities are not guarantied.

The administration formally reserves to itself the right to prescribe to the contractor, in the execution of the work, such modification as they may judge proper to make in the work as provided for, whether in regard to the form, the dimensions, or the method of construction, or in regard to the nature of the material to be used in the work, or in any other manner, and this without the contractor being able, by virtue of this matter, to raise any complaint or claim whatsoever.

Should the case occur, the administration will prepare a statement in which the works, as provided for, that the contractor will be relieved from executing and those that he must execute, not previously provided for, will be valued at a price greater or less, as may be, pro rata of the difference between the total amount of the detailed estimates and that of the adjudication.

The contractor will be held to accept the statement which will have been prepared by the Direction, unless objections and claims on his part may be considered as well founded, whether in regard to the price at which the work is valued or in regard to the quantity of the work which has been carried into the statement, in which case a new statement will be prepared, giving right, if necessary to his claims, and that the contractor can no longer refuse to accept.

ARTICLE 14.

No work not provided for, either on the plan or in the present contract and conditions, shall be allowed to the contractor, if the execution has not been previously authorized by the administration.

The work will be considered to have been done in the interest of the contractor and will remain at his expense.

ARTICLE 15.

The contractors are not allowed, except in cases of necessity and pressure, to make the workmen work on Sundays or legal holidays, or to admit upon the works children under the age of 13 years.

The infraction of these rules will be ascertained by the provincial engineer or his subordinates charged with the supervision of the works, by the communal administration, and by the agents of the local police.

The contractor will be liable to a penalty of 5 francs per day, to be retained from the amount of the adjudication, for each workman who will have worked on Sunday or a legal holiday and for each child under 13 years admitted upon the works.

In case of dispute as to the real infraction or as to the amount of penalties applied the contractor will be allowed to appeal to the députation permanente and he must submit to their decision.

The amount of penalties imposed shall be granted by the députation permanente to the bureau of charity of the commune where the infraction occurred or to a hospital if one exists in the locality.

ARTICLE 16.

Commencement and completion of the work.

The contractor shall commence the work within 10 days of the order that he shall receive from the administration; the work must be entirely finished the 1st of November, 1890, period at which it will be submitted to a provisory reception.

The reception shall be in the presence of the commission and shall be verified by a regular official report.

ARTICLE 17.

In the case where the contractor, by carelessness, ill-will, or lack of means shall refuse to comply within 10 days to the orders which may be given to him by the provincial engineer, the work will be proceeded with and the expenses resulting therefrom shall be deducted from the payment of the last quarter of the enterprise.

ARTICLE 18.

Fines and forfeits.

For each day of delay beyond the time established the contractor shall be liable to a penalty of 20 france per day; if this delay reaches 30 days, on the 31st day the contractor shall forfeit all his right to the undertaking and all expenses resulting therefrom shall be at his charge.

ARTICLE 19.

Delay.

The députation permanente alone accords an extension or delay in the finishing of the work. It alone also inflicts the penalties after having heard the province and the contractor interested.

The penalties that the contractor will have incurred shall be turned into the provincial treasury.

ARTICLE 20.

The contractor will be held to guaranty his work for the term of 1 year from the time of the legal provisory reception; he will keep it in perfect order during that lapse of time.

At the expiration of this time and before the route be recovered with a bed of sand 2 centimetres in thickness, the final reception shall take place.

Works left in suspense shall be executed officially and their cost be withheld from the amount of the 5 per cent. held for guaranty.

The final reception will take place in the presence of the commission and will be verified by a regular and detailed legal report.

ARTICLE 21.

The contractor can not, in any case, give over his undertaking to any one whatsoever, without the consent of the administration; the subcontractors that he may associate with himself will not be recognized by the administration.

ARTICLE 22.

All infringements of the stipulations contained in the present conditions will be verified by the provincial engineer; the legal documents will be prepared in duplicate, of which one will be delivered at the real or chosen residence of the contractor against a receipt signed by him.

The same mode of delivery will apply to other acts of which the notification must be verified in an official manner. In case of the absence of the contractor or his proxy, or upon the refusal to deliver the receipt, the delivery can be made at the residence, either by a registered letter through the post, at the expense of the contractor, or by the declaration of an agent of the direction establishing the delivery of the documents at the residence of the contractor.

ARTICLE 23.

All differences arising between the province, the provincial engineer, and the contractor shall be submitted to the commission, reserving appeal to the députation permanente, to whose decision the contractor must submit without further recourse.

ARTICLE 24.

Payments.

The payments will be made quarterly, in proportion to the advancement of the work, reserving the amount of 5 per cent. to serve as guaranty and which will be paid at the final reception of the work, deduction having been made for the amounts officially expended, of which mention has been made in Article 17.

The payments will be made in cash upon the certificates delivered by the provincial engineer verifying the portion to which the contractor is entitled. All payments made within 8 days following the delivery of each certificate will be considered as cash.

Fifteen days before the estimated time of the delivery of each certificate the provincial engineer of the roads shall inform the commission of the delivery of this piece to the contractor.

In case of delay in payment, there shall be 5 per cent. interest due to date from the eighth day after the emission of the certificate of reception, of which the contractor shall receive an official notice for his guidance.

ARTICLE 25.

Indemnities.

No indemnity shall be allowed to the contractor on account of losses, injuries, damages caused by negligence, want of means, or bad workmanship, unless it can be established that the injuries or delays came from a superior power and were independent of his will.

The contractor will be allowed to plead the superior power, whether for a claim of indemnity of any kind whatever, or to justify the nonexecution of any part of the work, or to obtain a remission of all or part of the penalties that he had incurred, only in case that, within 10 days of the circumstances or events from which may have resulted the obstacles or damages, he will have made known the situation to the administration.

ARTICLE 26.

The contractor shall comprise in his offer—

1. A sum of $1{,}134\frac{31}{100}$ francs for works unforeseen.

2. The expenses of printing, of advertising, of posters, of stamp and registering the conditions and legal contract of adjudication, valued at 200 francs.

The payment of these expenses shall be made within 8 days following the approval of the legal contract.

3. Three per cent. upon the total of the amount of adjudication to the profit of the province.

ARTICLE 27.

Security.

In order to take part in the adjudication the competitors must deposit in the national bank the sum of 4,000 francs either in cash or national bonds.

The receipt for the deposit must be annexed to the offer. Any offer to which this receipt is not annexed will not be considered.

The restitution of the deposits to the unsuccessful competitors will be made, with the authority of the governor of the province, immediately after the approval of the adjudication.

The amount deposited by the one obtaining the contract will remain in the national bank as security until the temporary reception of the work.

ARTICLE 28.

Method of adjudication.

The assignment will be made upon the offers addressed to the greffier (notary) of the province of Antwerp, by registered letters placed in the post at least 1 day before the date fixed for the adjudication.

The greffier, assisted by the delegates of the communal administration and chief engineer, will proceed to the opening of the offers in public session.

The offers, which shall contain stipulations other than those provided for in the given conditions, will not be considered.

The offers and the legal copy of adjudication will be submitted to the approval of the common council, and if necessary to that of the députation permanente.

Prepared by provincial engineer.

Antwerp, April 16, 1890.

(Signed.) ——— ———.

Seen and presented chief engineer, director.

Antwerp, April 17, 1890.

(Signature.) ——— ———.

FORM OF OFFER.

I, the undersigned (full name), contractor of public works, living at ——— street, ———, No. ——, do engage by this offer, under guaranty of all my property, real and personal, to undertake, upon the terms and provisions of the contract and conditions, all the work for the construction of a chaussée following the route No. 3 at Waerloos, in consideration of a sum of (indicate the amount in writing and in letters), putting on the work paving of the fourth sample (indicate the kind and origin of the paving stone).

Made at ——— ———, the —— day of ———, 18—.

(Signed.) ——— ———.

DISTRICT OF WAERLOOS.

Estimated expense of works to be executed in the construction of a carriage road following the route No. 3:

Description.	Dimensions.			Quantity.	Price.	Amount.
	Length.	Width.	Height.			
Earth works:	*Kilos.*	*Hectos.*	*Dekas.*		*Frs.*	*Francs.*
Excavation, filling in, and transport of earth.	.....	.....	.....	1,917.50 meters.	0.60	1,150.50
Digging ditches	.....	.....	.....	3,446.00 meters.	0.15	516.90
Turfing the ridge of the sideways.	3,446.00	0.25	.....	861.50 square meters.	0.20	172.30
Digging the coffer and furnishing the sand.	1,917.50	2.50	0.25	1,198.44 cubic meters.	0.75	898.82
Working up the profile of the sideways.	.....	.....	.....	1,917.50 meters.	0.15	287.63
Repairs of the earthworks	.....	.....	.....	1,917.50 meters.	0.10	191.75
Paving:						
Pavings of 0.14 by 0.16 (porphyry or stone) and borders, 4-inch sample, common limestone granite.	1,917.50	2.50	.....	4,793.75 meters		
Joining to the road	.....	.....	.....	75.00 meters.		
				4,868.75 meters	6.70	32,620.63
Repairs of pavement	.....	.....	.....	4,868.75 meters.	0.10	486.88
Travaux d'art:						
Aqueduct, 0.80 by 0.80 meter section.	.....	.....	.....	1 piece	.....	543.96
Aqueduct, 0.30 by 0.35 meter section.	.....	.....	.....	8 pieces	.....	876.32
Boundaries in cut stone	.....	.....	.....	80 pieces	1.50	120.00
						37,865.69
For work unforeseen	.....	.....	.....	.....	.....	1,134.31
Expenses of registering, printing, adjudication, etc.	.....	.....	.....	.....	.....	200.00
						39,200.00
3 per cent. to profit of the province	.....	.....	.....	.....	.....	1,176.00
Total francs	.....	.....	.....	.....	.....	40,376.00

The present estimate amounts to the sum of 40,376 francs.
Prepared by provincial engineer:
(Signature.)
Antwerp (Date).
Engineer-in-chief, director.
(Signature.)
Antwerp (date).

HIGHWAYS IN BELGIUM AND IN THE UNITED STATES.

REPORT BY CONSUL TANNER, OF LEIGE.

[From Consular Reports No. 24.]

While the Department of State is making such laudable efforts for the extension of our commerce and industry it behooves us not to lose sight of matters at home equally conducive to our prosperity.

In order to lay clearly and concisely my subject before the Department I will do so by presenting two pictures.

PUBLIC HIGHWAYS IN BELGIUM.

Americans who find themselves in Europe are struck with astonishment at the enormous loads drawn by horses and dogs here. One glance of the eye from the bulk just mentioned to the roads and half the wonder would be accounted for, because the roads have almost everything to do with it. We are too apt to ignore that which we trample under foot. The ancients knew and appreciated more the importance of good public roads than we do to-day, though at the present time in Europe this is a subject of first importance.

Many of the roads built by the ancient Romans and traveled by the proud Roman conquerors remain to this day. This is particularly the case in Turkey, where they have, ever since the Roman era, been in use with little or no repair. Of the numerous evidences left by them of their greatness and civilization I deem these roads the seal and stamp.

Belgium is divided into nine provinces, and each province is the seat of a well-organized State government, presided over by a governor. Each of the nine provinces, at each seat of government, has a bureau for roads and bridges whose chief gives his undivided attention to these things.

The roads are most carefully engineered in the first place, heavy grades, even in mountainous localities, being carefully avoided. The roads are built in an oval form, and in most cases are paved with stones; in others gravel forms the road bed, and still in others gravel covers the stone, which, soon becoming hard and smooth, makes the best road bed of all others, because the jolts and noise of a paved road, which are both tiresome and disagreeable, are avoided, and then the wear and tear are not so great on the running gear, and this kind of road is decidedly more agreeable to pedestrians and possesses, in addition to other advantages enumerated, the advantage that if the gravel washes away the stones remain and a good road is always assured.

The stones composing the roads are of a blunt wedge shape, 4 or 5 inches square, and are quickly laid and quickly taken up if necessary. These stones are uniform and regular in size, and, when placed, dirt is placed over the new pavement and then a large roller, drawn by four horses, is passed and repassed over it until the stones are well settled in their places and the crevices filled with earth. In constructing roads here regard is always paid to locality and liability to wash. Where there is no danger of washes stones are dispensed with altogether and an oval-shaped gravel road substituted at less cost, but in all cases the sides of the road receiving the drainage and where it is apt to show first symptoms of yielding to bad weather are carefully paved so that washes and gullies can not commence in that quarter.

These roads are flanked on either side by two, and sometimes four, rows of shade trees, which add much beauty to the country through which they run, and from a distance are particularly picturesque where several roads intersect. One can mark the roads in their windings sometimes as far as the eye can reach by these fresh green shade trees, which, with the various teams of horse and dog laden with the products of farms, mines, and shop, conspire to make a very pretty scene. I never look at these roads but what I think of the enormous blessing and luxury they would be in certain sections of our country.

The public roads of Belgium enter into successful competition with the railroads, so much so that a man who has his team does not by any means consider himself forced to send his products by rail. It is one of the commonest of sights here in Liege to see wagons laden with merchandise from Brussels, which is 60, or from Antwerp, which is 72, miles from this place; this fact does not possess anything astonishing until the enormous loads pulled that distance by one horse is considered, and there is nothing that so astonishes the American as this. Sometimes the wagon itself looks like a sufficient charge for two horses, while wagon, load, and all are drawn by one with the greatest ease. Those horses are of a larger and stronger build than our horses, and from their size and strength are called in England "En-

glish drafts." Place the same load on almost any of our roads in the United States, and at least two more, if not three more, "English drafts" would be required to pull it the same distance. Dog carts come to this market, laden with beef and other products of the farm, a distance of 12 and 15 miles, drawn by one dog. Two grown, persons return in the wagon.

AMERICAN HIGHWAYS.

In presenting the other side of the picture the task is not an agreeable one because I will have to write some very disagreeable things. Can it be said that we have any public roads in the United States? I have only made the acquaintance of the public roads in the Western and Southern States, and there is only one within my knowledge that can make pretentions to being called a road in the Belgian sense, and that is in the Valley of Virginia. Most of the others that have come under my notice are little short of bogs, swamps, and marshes, and the bridges man-traps. These roads are utterly at the mercy of the weather, and are passable or impassable according to it, and are entirely out of keeping with the enlightened and intelligent people who, through apathy, patiently endure such a state of affairs.

I have been in certain sections of the South, in the fall and winter months, when the farmer had gathered his crop, and when the business season would naturally be good, when the farmer would go to market, make his sales, and return with merchandise and heard the most dismal complainings of dull business and "hard times." This is the case simply because in most cases the roads are utterly impassable, the distribution of products is at a standstill, and of course dull business follows. There are few outside of these sections that know the real condition of these roads. The emigrants, however, know more on the subject than many Americans, as I will show further on. I have been on the roads and seen a poor old Rosinante tugging away at a wagon stuck in the mud almost out of sight; when released from his gear he could hardly pull himself out of the mire. Some of these roads are marked with skeletons of horses that have been beaten to death or drowned in the mud or some bridgeless stream, and wrecks of wagons and other vehicles mark the place of an accident to some one who had courage enough to venture out on the road. I was in one of the most beautiful of our Southern cities last winter, and while there read a glowing account in one of the newspapers of the place of a horse having been smothered in the mud, and this on one of the principal streets of the city. When poor roads prevail in a section, everything else is very apt to be poor—the horse, the farmer, and the merchant, and the church.

Where good roads prevail you find a community that would be loth to give them up.

It is a well-known fact that in spite of the strenuous efforts made in some sections of our country to induce emigrants to settle among them, very few accept the invitation. I am in a position here to know something of the emigrant. He generally posts himself pretty thoroughly about a section before he goes to it. This is made easy by the numerous emigrants who have preceded him, and he is sure to have acquaintances in several sections who give him information. I have invariably been informed by them that they would not go to a section where the roads were impassable. This is their only objection. They inform me that they would gladly go to such sections, but that they do not wish to be mud-bound or mud-blockaded for six months in the year. I can say to such sections that they must make good public roads before they can induce emigrants to come among them. If it is economy that restrains, it is a false economy; every day that they allow their public roads to remain in an impassable condition, their streams to remain without bridges, they deal a direct and severe blow at their own interests; the country will remain undeveloped, its hidden treasures locked up. These roads, if improved at once, newly engineered, and made good roads, with permanent bridges that could not be swept away with every rise in the stream, would give some sign of permanence of settlement, and of contentment with the section; the burden of the tax would soon be shared by so many that the roads

would not only be self-sustaining, but would be a source of revenue to the State. The taxes would return in the improved condition of stock and running gear, and of the increased loads that could be sent to market in wagons. Circulation, which is the backbone of business, would be facilitated; where now it is a hazard and a task to venture on the public highways it would become a pleasure. In short, there are few blessings that any community can know equal to that of having first-class roads. But unless roads are made first-class, to commence with, you will never have them, and you throw away the money you invest in them.

GEO. C. TANNER,
Consul.

UNITED STATES CONSULATE,
Liege and Verviers, August 1, 1882.

BRUSSELS DISTRICT.

REPORT BY CONSUL ROOSEVELT.

STREETS.

Owing to the numerous quarries existing in Belgium, very little else than stone is employed in paving the streets and highways, in and around Brussels. A few streets in the center of the city, as well as the sidewalks of the railway stations, are paved with condensed asphalt, coming from Val de Travers. On account of the peculiar situation of the city, the majority of the streets are of too precipitous an incline to permit the successful condensation of asphalt. Wood paving is employed on some of the boulevards.

Asphalt paving.—Streets destined to receive asphalt are constructed in the following manner: The soil is removed to a depth of 6 inches, the ground then leveled into shape, preparatory to receiving a deposit of concrete, composed of Portland cement and gravel, upon which the asphalt is applied to a depth of 2 inches. The method of laying wood pavement is similar to that employed in the United States.

Stone paving.—Primary preparation of streets to be paved with stone is identically the same as when asphalt is employed. A deep bed of sand is, however, deposited instead of concrete, upon which paving stones, known as Belgian blocks, are placed in transverse rows, and firmly fixed in a smooth and comparatively compact mass, by use of a heavy paving ram worked by hand, a slight sprinkling of sand is applied and the street declared ready for traffic.

BOULEVARDS.

The boulevards of Brussels, forming a continuous and beautiful circuit around the city, are abundantly planted in fine, large elms, maples, sycamore, and chestnut trees, affording delightful promenades to pedestrians and equestrians, as well as fine carriage drives.

The boulevards vary in width according to section of city which they traverse. They are divided into roadways for tramcars and heavy

traffic, walks for pedestrians, and roads for carriages and equestrians. The walks devoted to pedestrians are constructed from pulverized granite covered with a sufficiently deep layer of sand rolled hard and smooth, and afford agreeable promenades even in wet weather. The roads are built on similar principles as ordinary roads, that is, the ground is excavated to an agreed depth, say from 10 to 16 inches, and filled in with the paving material. The roads devoted to equestrians are filled in to a depth of 16 inches with broken brick, which after being leveled into shape is covered with a thick bed of sea sand. The carriage roads are paved in part with asphalt, wood, and also broken and pulverized granite, the latter producing a fine macadamized roadway.

The pavements and paving stones, their origin, duration, and cost are as follows: Porphyry, from quarries at Quenast and Lessines, estimated duration 75 years; sandstone from quarries at Ecoussines, estimated duration 60 years. No. 4 from the vicinity of the rivers Ourthe and Meuse, estimated duration 40 years; limestone, no longer accepted by the city government, estimated duration 25 years.

Porphyry, per square yard, 9.50 francs ($1.83); sandstone, per square yard, 8.50 to 9.50 francs ($1.64 to $1.83); asphalt from Val de Travers, per square yard, 17 francs ($3 .27); wood on concrete foundation, per square yard, 11 francs ($2.12); the two last named pavements are highly esteemed and m uch employed on the boulevards.

HIGHWAYS.

Roads in Belgium are divided into three categories and distributed under the following administrations:

1. Government roads under the administration of bridges and roadways (civil engineering).
2. Provincial roads, controlled by the provincial government.
3. Communal roads, controlled by the communal authorities.

Dimensions.—Government roads: Width of roadway, 5 yards 20 inches; width of sidewalk, 2 yards 8 inches; width of ditch, three-fourths yard.

Provincial roads: Width of roadway, 5 yards 20 inches; width of sidewalks, 2 yards 27 inches; width of ditch, three-fourths yard.

Communal roads: Width of roadway, 4 yards 16 inches; width of sidewalk and ditch, 1 yard 24 inches.

Materials.—These roads are paved with native porphyry and sandstone of following dimensions: 7 by $6\frac{1}{4}$ inches, $6\frac{1}{4}$ by $5\frac{1}{2}$ inches, $5\frac{1}{2}$ by $4\frac{3}{4}$ inches, $4\frac{3}{4}$ by $3\frac{1}{2}$ by $8\frac{1}{2}$ by 7 inches, $4\frac{3}{4}$ by $3\frac{1}{2}$ by 7 by $5\frac{1}{2}$ inches. Curbstone, 30 by 15 inches each side of road.

Cost of construction of road destined for frequent and heavy traffic, per square yard.

Preparing bed 12 inches deep	$0.03
Ashes	.09
Paving stones 6¼ by 5½ inches	1.31
Labor	.04
Total	1.47

Ashes per cubic yard 30 to 40 cents; sand per cubic yard, 48 to 58 cents.

With rough or broken stone.

Preparing bed 12 inches deep	$0.03
Rough stone, 8 inches deep	.16
Broken stone or pebbles, 2 to 4 inches deep	.11
Labor	.04
Contractor	.03½
Total per square yard	.37½

Cost of maintenance.—Country roads, per running yard, 4 cents; near industrial districts, 6 cents; proximity to sugar factories, 6 to 10 cents.

Roads are annually inspected and repaired as follows:

From 25 to 20 consecutive yards out of every 4,000 or 5,000 yards of pavement are taken up and replaced by new material. On roads devoted to heavy traffic, paving stones 7 by 6½ inches are employed, as also on inclines averaging less than three-fourths of an inch per yard. On inclines averaging more than three-fourths of an inch per yard, stones 6¼ by 5½, or heavy oblong stones 4¾ by 3½ by 8½ by 7, are employed. Where the soil is very firm, sandstone blocks 7 by 6¼ inches are preferred, which, with heavy oblong stones, are also used on inclines according to declivity. Satisfactory drainage is produced by depositing a deep bed of ashes prior to placing pavement. On roads of light traffic blocks 4¾ by 4¾ inches are used on the level. While 4½ by 3½ and 6⅛ by 5 inches are employed on inclines.

Contract for keeping roads in repair is by public bid, and is awarded to lowest bidder for a term of three years, the average cost of repairs to roadway 5 yards, 20 inches wide, as follows: Porphyry blocks, per square yard, 6 cents; sandstone per square yard, 5 cents. The value of land lying near or adjacent to improved roads is increased according to proximity to some large city or industrial center.

GEO. W. ROOSEVELT,
Consul.

UNITED STATES CONSULATE,
Brussels, February 23, 1891.

FLANDERS.

REPORT BY CONSUL OSBORNE, OF GHENT.

I. CITY STREETS.

The material and its sources.—The exclusive paving material for all the towns in the provinces of East and West Flanders, indeed, practically of the entire kingdom, is Belgian blocks. These are of sandstone of different degrees of hardness. There are three recognized varieties. First, those from Ecoussines, province of Hainaut, which are of medium hardness and smoothness. It is these quarries which supply most of the paving material. The same locality also furnishes a blue limestone, sometimes called Flemish granite, which is cut into slabs and used for the curbstones. Second, those from Quenast, province of Brabant, which are very hard and smooth. Lastly, those from the neighborhood of the river Ourthe, province of Liege, which are least hard and rather rough. Superior blocks for sidewalks are obtained from Lessines, in Hainaut.

Methods of building and maintaining.—The paving stones are generally in cubic form, but lately rectangular ones are preferred. There are eight sizes used for paving, of which I give below the dimensions of the five principal ones. Numbers 3 and 4 are those used in Belgium, especially the latter. The largest size is only used in large cities.

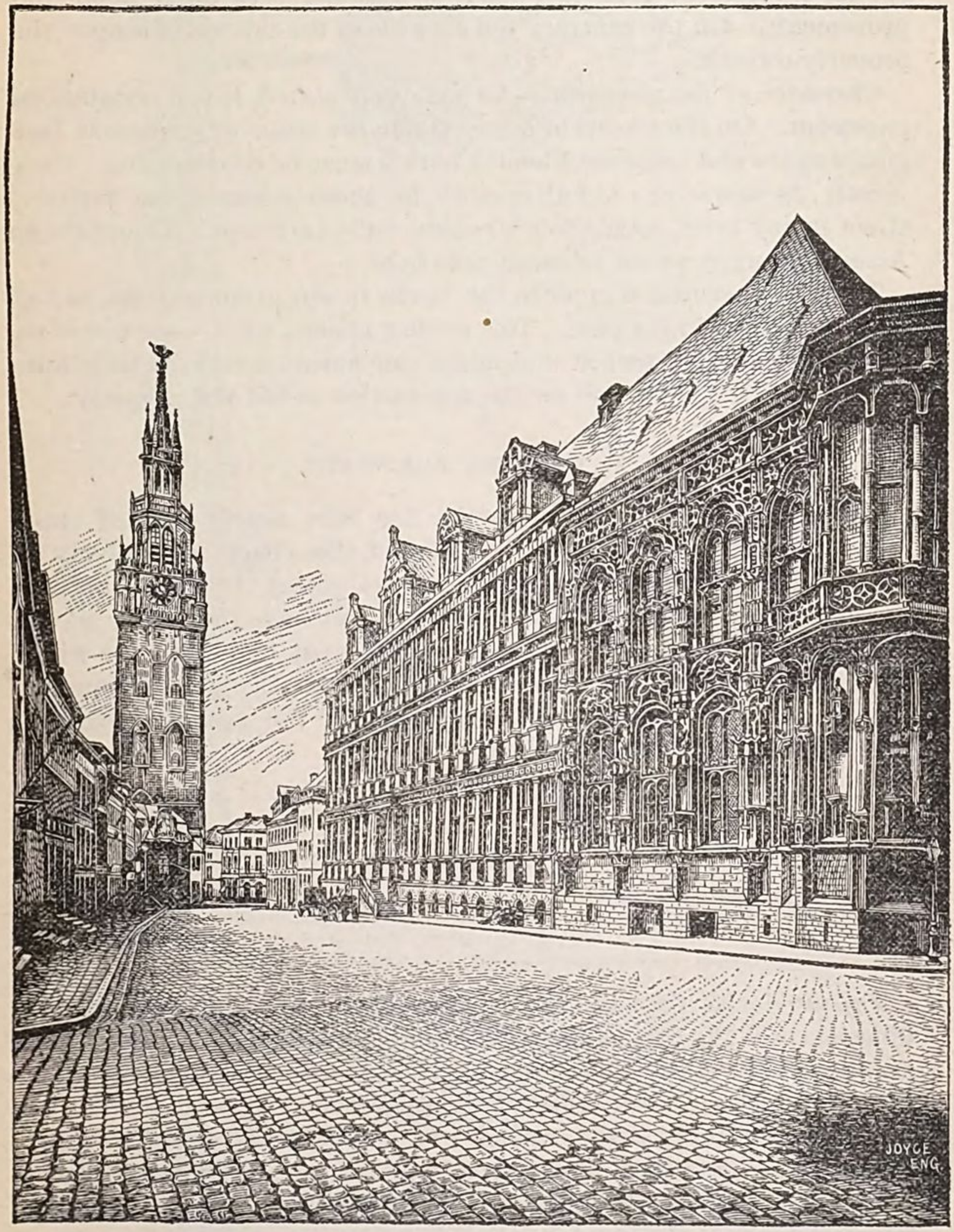
Dimensions.	No. 2.	No. 3.	No. 4.	No. 5.
Paving blocks:	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Length	7 to 7.8	6 to 7	5.7 to 6	4.7 to 5.7
Breadth	7	6	5.7	4.7
Thickness	7	6	5.7	4.7
Blocks for border:				
Length	11.8 to 15.7	11 to 15	10 to 14	9.4 to 13.4
Breadth	7	6	5.7	4.7
Thickness	13.7	11.8	9.8	7.8

The process of laying the pavement is simple. First, the soil is removed to a convenient depth and the "form" is prepared by leveling the ground in the shape it will have when the pave is completed. A bed of sand to a depth of half a foot is then deposited. On this the blocks are laid in transverse rows conveniently close together, the joints always coming to the middle of those of the contiguous rows. Next, they employ an iron paving ram weighing about 35 pounds, and worked by hand. With this they strike each stone, strengthening and smoothing the whole. Lastly, a thin coating of fine sand is put on, which gradually penetrates the crevices. The street is then ready for use.

The stones for the border are somewhat larger, as shown in the above table, than the other blocks. Next to these come the curb-stones, which are of varying dimensions and are placed upright, the top level with the sidewalk.

The sidewalks are constructed similarly to the roadway, except that the blocks are usually superior and cemented together.

The pave is a durable one and few repairs are necessary even on a street of heavy traffic. However, when they are made it is a simple matter, generally the readjustment or substitution of a few blocks.



The streets are kept scrupulously clean, usually by hand. In Ghent sweeping machines traverse the principal streets at night. The city government has charge of this work.

Cost of construction and repairing.—The cost of construction varies from $1.04 to $1.21 per square yard for the ordinary size of block No. 4, the materials being included.

The expense of repairs averages from 2 to 4 cents per square yard.

Both the building and repairing are at the expense of the city. No special assessment is levied, but it is included with other public improvements. On the contrary the expense of the sidewalks is upon the property-owners.

Character of the pavement.—As has been stated, it is a substantial pavement. On the streets of heavy traffic the strain of ponderous Belgian wagons and immense Flemish horses must be considerable. Conversely, its character and universality, for there is scarcely an unpaved street in any town, necessitate strongly built carriages. Therefore an American buggy would be unsuitable here.

There is a peculiar danger to the towns in the event of riots, as has been illustrated in the past. The paving stones, when once one is removed, are easily detached and make convenient and formidable missiles in the hands of a mob for the destruction of life and property.

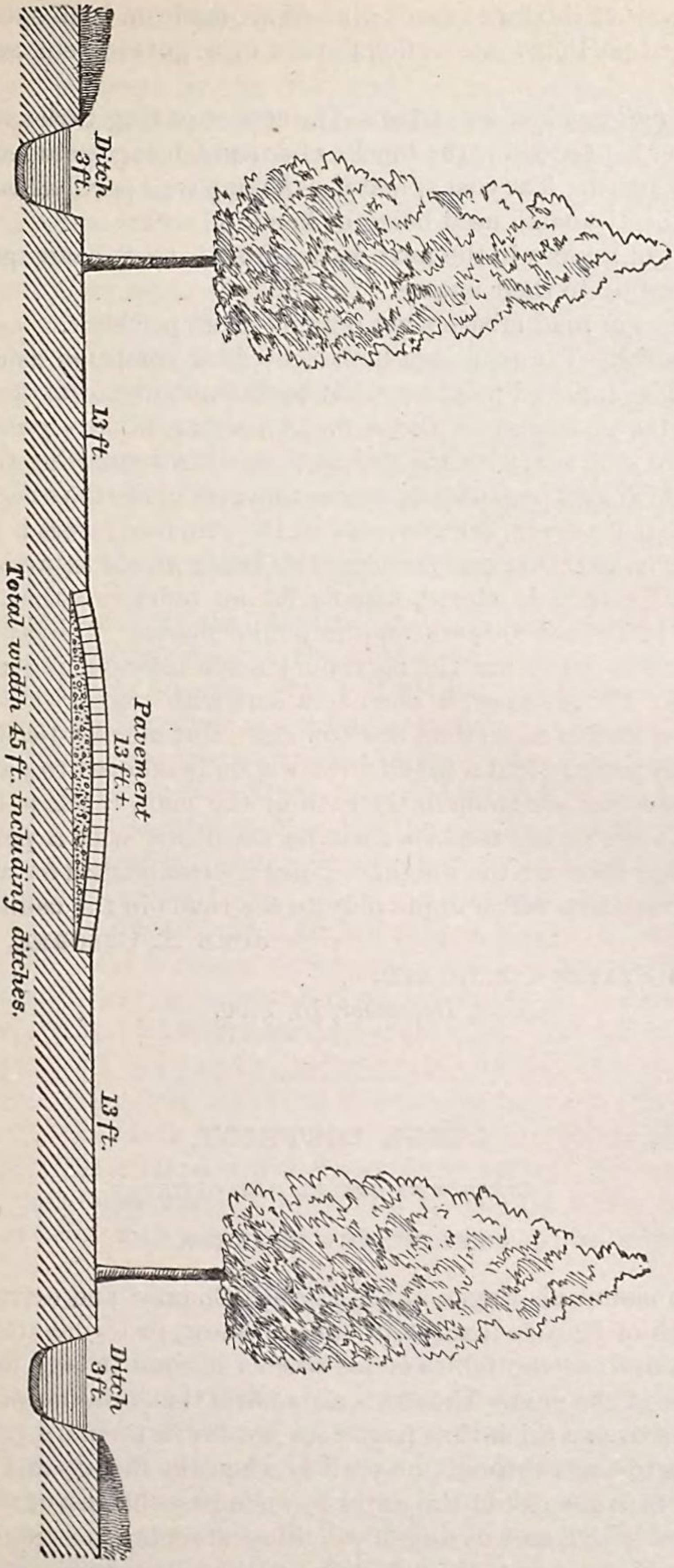
II. COUNTRY ROADWAYS.

The number of roads in the country has been nearly doubled since 1830. There are four kinds to be considered, those made respectively by the central government, the provincial government, communal authority, and by private individuals. The roads all have the center paved in the style of the streets. Except on the great highways, the width of this paved portion rarely permits the passage of two teams upon it. The following are the average dimensions of the great government roads traversing the city of Ghent:

Road.	Total width.	Width of paving.
	Ft. In.	*Ft.*
Antwerp to Lille via Ghent (France)	42 8	15
Brussels to Ostend via Ghent	44	16
Ghent to Valenciennes (France)	40	13

The provincial roads connect less important places and have inferior dimensions. The communal roads or *chemins vicinaux* comprise all the small country roads. The last class, those made by individual enterprise, or *Routes concédées*, are constructed with the permission of the government entirely at the expense of the individuals, who also engage to keep the road in repairs for a certain period, usually 99 years. In return they are allowed to charge toll for this period. At its expiration the road becomes the absolute property of the Government.

Method of construction.—The manner of paving the central portion is the same as that employed for the streets. The earth taken out is thrown on either side upon the unpaved strips.


Ditch
3ft.
13 ft.
Pavement
13 ft.+.
Total width 45 ft. including ditches.
13 ft.
Ditch
3ft.

In the case of the large roads ditches are made on both sides beyond the unpaved portions. A sectional view of a government road is appended.

Cost of building and repairing.—The cost of paving varies from $1.10 to $1.21 per square yard, the blocks and sand being included and size No. 4 being used. The cost of making the unpaved portions is comparatively slight, the earth used being at hand.

The cost of repairs in the pave varies from 5 to 8 cents per square yard, according to their nature.

The wages of road laborers are 6 and 7 cents per hour.

Maintenance.—The roads are kept in as good condition as can be expected. The unpaved portions easily become muddy, owing to frequent rains and the character of the soil. An extraordinary precaution is taken when it thaws, which is no less than a law regulating the weight of loads which may pass during the continuance of the thawing. At the moment that it sets in, the governor of the province issues a proclamation that "*les barrières sont fermées*," this being an old expression signifying that the road is closed, usually for an indefinite time. This is published in the newspapers and in public places. The law provides with exactness what are the maximum loads allowed under different conditions. For instance, a one-horse cart with narrow tire can not pass with a load of more than 880 pounds. But a broad-tired one may weigh 1,540 pounds, and a broad-tired wagon is allowed to pass with a ton. Exceptions are made in the case of the mail, coaches, carriages, and army wagons, but the last must be furnished with a permit from the governor showing the weight. Fines are established for a violation of these provisions which apply only to the roads in the country.

JOHN B. OSBORNE, *Consul.*

UNITED STATES CONSULATE,
Ghent, December, 16, 1890.

LIÈGE DISTRICT.

REPORT BY CONSUL DANFORTH.

PRELIMINARY REMARKS.

One can mount his wagon at the English Channel and drive through the breadth of Europe (except in time of snow) or its length, without sinking as deep as the fellies of his wheels in mud in any weather or at any time of the year. The roads are so firm that rain does not soften them; they are so thick that frost does not break them up. There are no sloughs to wade through, no periods when the factory and the farm are cut off from the rest of the world by an impassable sea of mud. Two horses start with a cart or wagon weighing a ton, having upon it a load weighing two or more tons, and arrive with no breakage and at least

friction to their destination. The loss in breakdowns of vehicles, of breakage in harness, in time to labor, in increased food, shortened life, and injuries to horses by our bad roads in the United States would amount to an immense sum of money if statistics could be gathered and formulated. Without doubt the economy from this one source would go far towards keeping a road in repair when once it was thoroughly constructed where traffic is considerable.

The economy of good country roads to those using food and fuel in our large but more especially our small cities is also to be emphasized. Railroads, also, are directly interested in good country roads. Whatever opens up the remote farm lot for easy hauling to the railway station, or brings an additional acre of arable land nearer to the city, cheapens the market for the poorest and increases the volume of trade and commerce for all. The whole community shares in the benefit, and can therefore afford to share in the expense of building and keeping such roads.

PRESERVING THE LANDSCAPE.

The chief material for the construction of durable roads is rock of some kind; the harder the rock the better the economy, other things, such as accessibility, vicinage, etc., being equal. A hard-rock country usually possesses a beautiful or a sublime landscape. Nature has taken thousands of years to construct that land scape. From the beautiful valley of the Ourth, not far from Liège, immense supplies of stone are taken for city streets and country roads. Yet the great picturesque ledges of rock repose untouched in the same sublime forms into which the ages and the storms have fashioned them. Stone quarries have been opened from ridges behind the river fronts of the hill ranges, and by cars attached to wire ropes the stone is passed down to the river and directly into the boats and carts at less expense than it would have taken to work quarries near the river bank. Gravity does most of the work. The full car from the high hill lets itself down and pulls the empty one up. It is to be hoped that improved roads will not result in damaged scenery. The two advantages of good roads and unmarred scenery are compatible where the spirit of taste is blended wth the spirit of utility. When it is remembered that unblemished scenery has its market value, commanding a higher price, men may be induced to veil their assaults upon the hills.

STREETS.

The extent to which squared hewn stone is employed for street and sidewalk and scarcely anything else, creates an appalling monotony of Belgian pavement in the cities of this consulate. The sidewalks reproduce, in miniature cubes of 4½ inches by 4½ inches, the appearance of the streets, which one could wish himself shod in iron to escape the discomfort and pain caused by the inequality of these torturing cubes. The stone slab and the asphaltum walk are luxuries belonging to other

parts of our planet. Nor is there such traffic in our city streets, either in weight or amount, that compels resort to those expensive foundations employed in the immense cities of London and Paris.

I give below the cost in construction and maintenance of this city of Liège possessing 165,000 inhabitants. It is in the midst of a densely populated industrial district and heavy loads of iron and coal are trucked upon the streets. This street traffic is much heavier than in most cities of a similar size in the United States. The square cubes of stone are laid upon beds of broken stone or ashes in the more prominent streets; in other streets upon the natural beds of the earth with a slight layer of sand as an absorbent, the curve being about 1 in 30. Curbstones measure 7½ inches in width, 3½ to 6 feet in length, 1 to 1½ feet in depth, and are tongued and grooved at the ends to about 1½ inches. The paving stones or blocks still used here have been rejected as too large for the best results where the heavier traffic of larger cities is more exacting. They wear round and knobby, become slippery, and are moved to inferior streets, whence they are finally removed to be broken into small stones for roadbeds and for park, boulevard, and country roads.

It is to be regretted that the natural twofold division of city streets and country roads suggested by the department can not be strictly followed in this report. The streets and roads of Belgium are peculiar. They interblend. We have city streets partly constructed of paved ways and partly of broken stone, while into the country extend the paved crowns of square blocks of stone with broken stone roadways upon each side. It may therefore be of interest, and not without profit, if the classification observed in Belgium by the Government is outlined, bearing in mind that some of the Belgian country roads resemble some of our city streets lacking curbstones.

The streets and roadways of Belgium are built and maintained by three different authorities—the state, the province, and the commune (the city or the village).

But the supervision, in the last resort, belongs to the state, that through its engineers and supervisors must approve of all that has been planned or accomplished in the construction and repairing of roads, or granting concessions for small rail or tram roads to use the common roads. No material can be used in building or maintaining roads unless the state approve of it. It is, however, generally admitted that the material, that is the nearest, has to be considered in the first place; but where there is no kind of material near the place the very best is to be procured. The material generally used is granite, grit, and limestone.

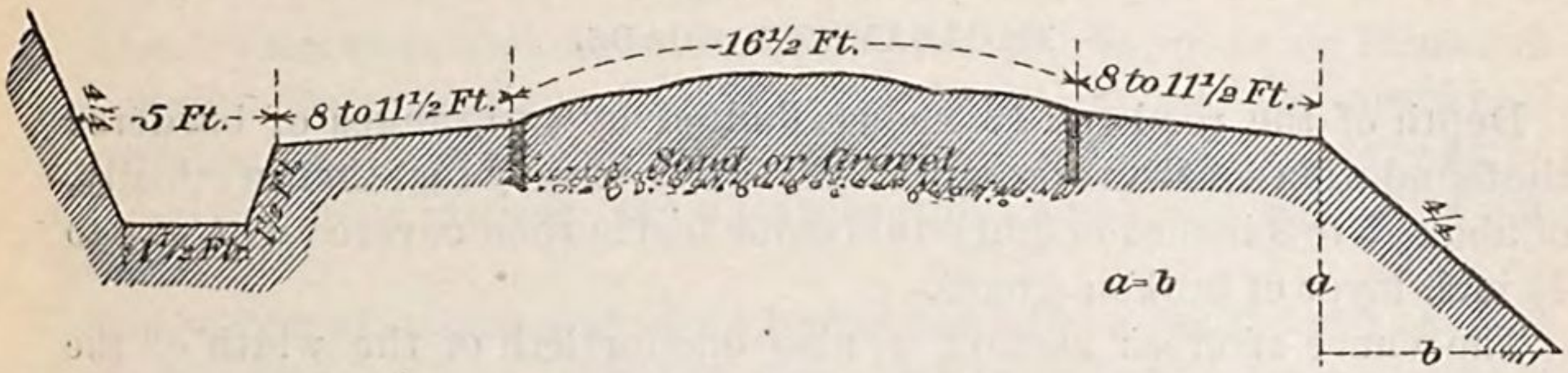
The building as well as the maintenance of roads is done in three ways: By sealed bids, in which case the lowest bid is considered if a responsible person. He has to build or maintain according to the plans previously published in conformity with detailed specifications.

(2) The streets or roads are built or repaired and maintained under the supervision of the state, the province, or the commune. This way is called by *régie.*

(3) Sometimes the two methods are combined.

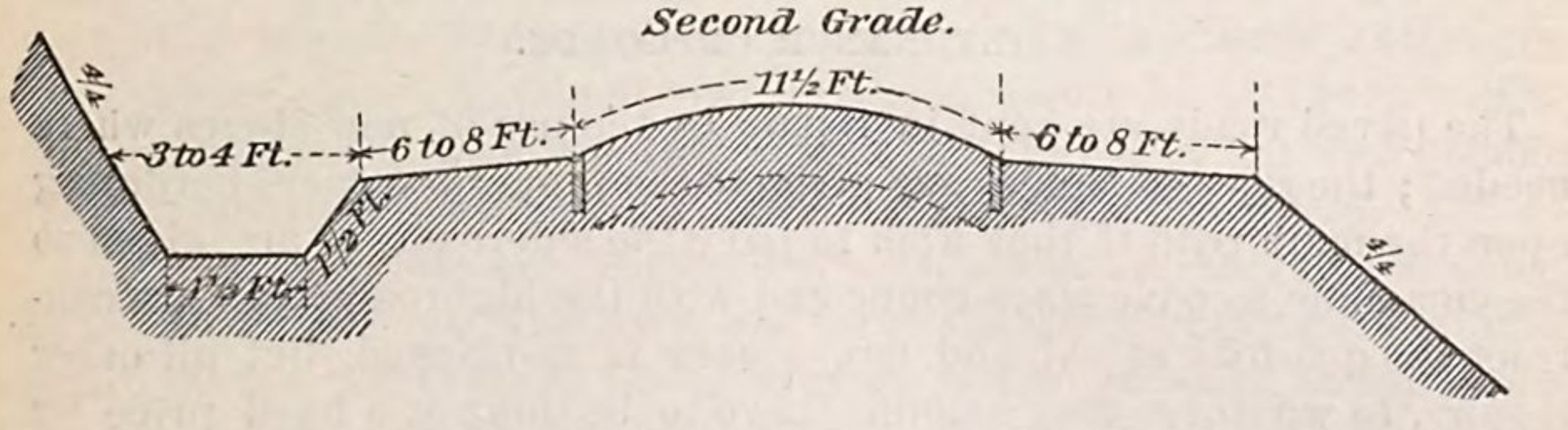
Highroads are of three grades:

First Grade.



First grade, width within the borders 16½ feet; sidewalks, 8 to 11½ feet; ditch, 5 feet; depth, 1½ feet to 1 foot 8 inches.

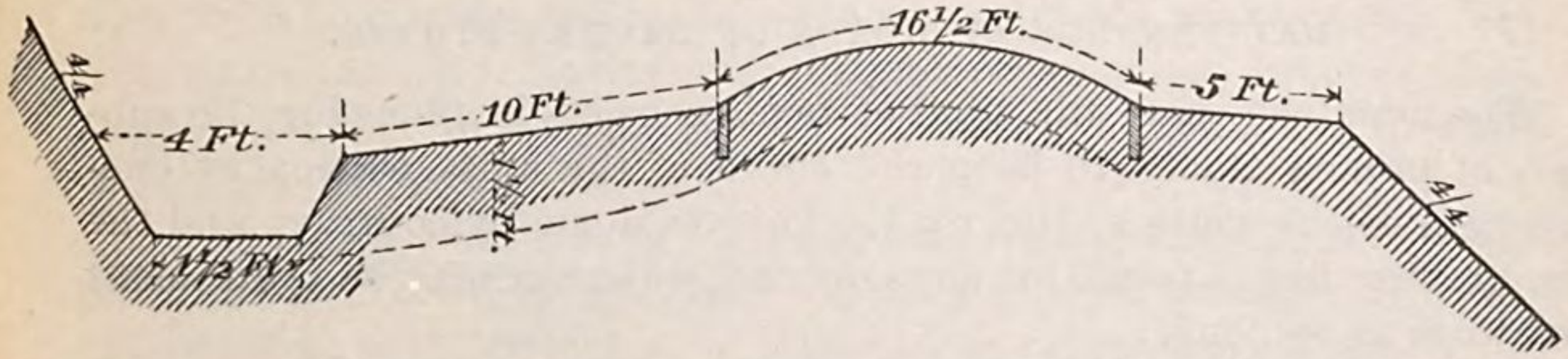
Second Grade.



Second grade, width within the borders, 11½ feet; sidewalks, 6 to 8 feet; ditch, 3 to 4 feet.

Third grade, width within the borders 10 feet or even less.

New road destined to receive a small railway or tram.



Where the highroad is designed to receive a small railway a sideway is constructed for the purpose, whose foundation is 1½ feet, with a width of 10 feet.

PAVED ROADS.

The paving stones 6 to 6⅔ inches in width and 6½ to 7 inches in depth. These 6½ to 7 inches with the foundation form the roadway, which is generally 12 inches.

The roadway is maintained by two sets of borders, having the same width as the paving stones and 11 to 14 inches in length; in height they fill generally the whole depth of about 12 inches. Under the pav-

ing stones is a layer of sand, gravel, or ashes from a zinc mill, of 8 inches; this is rammed to the prescribed curve of cross section, which is one-fortieth of the width of the road.

The cost of these roads varies according to the material and the distance they are from the place where they are to be employed.

The average cost of construction is $1.13 a square yard.

MACADAMIZED ROADS.

Depth of the roadway 12 inches, limited by two ranges of borders; the foundation consists of rough stones drawn closely together, vertically, of about 7 to 8 inches height; this stone bed is then covered with a 4 to 4½ inch layer of broken stones.

The curve of cross section is also one-fortieth of the width of the road.

The cost of building varies as in the case of paved roads. The average cost is 40 cents a square yard.

MAINTENANCE OF ROADS.

The paved roads are kept in repair by the use of new stones where needed; the rejected stones are given to the property owners bordering upon the main road if they wish to pave the sideroads, or are given to the commune to pave ways connected with the highroads. In the contract the quantity of old and new stones is mentioned, but all other repairs, to whatever they amount, have to be done at a fixed price by the contractor.

The average cost per yard is $0.01775.

However, in city streets, where only new stones are employed, the average cost of maintenance is about $0.041945 per square yard

MAINTENANCE OF ROADS OF BROKEN STONES.

The maintenance of this kind of roads consists in renewing the supply of broken stones to keep the curve of the cross section at one-fortieth of the width of the road. This is done by contract and the contractor has to fulfill his engagement, whatever may be the amount of work to be done.

The cost is about $0.0129 per yard.

Experience has shown that the value of the ground is in direct ratio to the good condition of the streets and roads by which they are traversed.

"Indeed it depends on the state of the roads and ways to improve the soil to put to profit the forests, mines, and industrial plants," are the words of the engineer of public roads and highways, with which I close this report.

JAMES R. DANFORTH,
Consul.

UNITED STATES CONSULATE,
Liège, February 24, 1891.

DENMARK.

REPORT BY CONSUL RYDER OF COPENHAGEN.

HIGHWAYS.

The construction and maintenance of the public roads in Denmark are under the management and at the charge of the local municipal boards, subject however to State supervisal, and these roads may be divided into four classes, according to the extent and nature of the traffic.

In the first class are placed such roads as have a daily passage of at least 100 vehicles, and which at the same time have a large traffic of heavily laden wagons. Such description of traffic in this country may now be confined to the limit of the nearest one-half Danish mile (1 Danish mile = $4\frac{3}{4}$ English) leading to the main entrance of the principal provincial towns. The chief characteristic of this class is a strongly built substructure capable of bearing the pressure of all heavy traffic (however light the wear and tear superstructure might be) with a good superstructure of broken stone of about 10 inches in thickness.

In the second class are reckoned such roads as are frequented daily by 50 to 100 vehicles, with some but no considerable heavy goods transport. Such description of traffic may be said to embrace all the more important public roads beyond the one-half mile limit leading from the towns. The main feature of this class is a good foundation with a wear and tear superstructure of screened rubble or of small broken stones of about 8 inches in depth.

To the third class belong all roads with slight carriage traffic, say from 20 to 50 vehicles daily, and without any goods conveyance. This class has a strongly constructed superstructure about 8 inches thick, composed either of screened gravel or of broken stones, with a substructure of unscreened rubble.

To the fourth class belong all roads with a daily passage of less than 20 vehicles. This class of roads has only a superstructure of 3 to 4 inches thick, composed either of screened or unscreened rubble.

In the substructure of these different classes of roads a greater excavated mass than of 10,000 cubic fathoms (about 66,700 cubic metres) per Danish mile for the first class seldom occurs. In the second class the excavated mass will seldom exceed 5,000 cubic fathoms per Danish mile; and for the third and fourth classes, such excavation as a rule will be under 15,000 cubic metres and not unfrequently even below 6,000 cubic metres per mile. The full breadth of the different classes of roads,

with the deductions for side paths, ditches, etc., and the breadth of the carriage road are as follows, viz:

Description.	Full breadth of highway.	Deductions for sides.	Carriage road.
	Feet.	*Feet.*	*Feet.*
For first-class road	32 to 40	16 to 20	16 to 20
For second-class road	28	14	14
For third-class road	24	12	12
For fourth-class road	20	10	10

The drains beneath the roadways are as near as possible of similar construction for the three first classes; in most cases with granite sidewalks and pavement, the whole being covered with a thick layer of clay. It is only an exception when the drains are of brickwork. In the later years glazed drain pipes have, however, been often used for drains of smaller dimensions. For the carriage ways, the dimensions of which have been given, in the first-class roads the substructure as a rule consists of irregularly broken stones 5 to 6 inches in diameter, packed closely by hand; or else of a layer of coarsely screened gravel containing stones up to 4 inches in diameter; which after the addition of a thin layer of small hand-broken stone of 1 to 2 inches in diameter is rolled until well bound together; whilst the wear and tear superstructure will generally consist of small granite road metal of about $1\frac{1}{4}$ inches in diameter. This layer is at times divided into two parts; namely, of a lower stone layer of $1\frac{3}{4}$ inches with an upper layer of stones of $1\frac{1}{4}$ inches in diameter; the whole being firmly bound together with an addition of sand gravel strewed over the path after one or two passages have been made by the rolling machine.

For the second-class roads will be used a similar wear and tear superstructure of hand-broken road metal or else of screened gravel, the choice depending in great measure on the difference in cost of the two materials at the spot where the work is carried on. Where the traffic is of lighter nature the screened gravel is found a very good material once the road has become well consolidated. The difference in price is matter of some importance, the cost of hand-broken stone varying from $8 to $21 per cubic fathom, whilst the screened gravel may be obtained for $2.68 to $8.

On the third-class roads, the wear and tear superstructure as a rule is simply laid on a foundation of 3 to 4 inch layer of coarse screened gravel, and as soon as this is somewhat consolidated by traffic or rolling a superstructure is laid, consisting either of hand-broken stones or of screened gravel 2 inches in thickness.

The cost of construction of new roads is very difficult to give with any certainty. It will depend not alone on the class of road, but also on the nature of the ground, as well as the difficulty in obtaining the materials, the extent of drain works, etc.; but, speaking generally, it is said that a first-class road, exclusive of expropriations, will cost from

80,000 to 100,000 kroners ($21,440 to $26,800) per Danish mile (4¾ English miles); the second-class roads from 50,000 to 80,000 kroners ($13,400 to $21,440), and the third-class from 30,000 to 50,000 kroners. The minimum cost of the fourth-class byroads, with fairly regular ground and good approaches, may be placed as low as 5,000 kroners ($1,340) per Danish mile, although this may more often approach to the sum of 10,000 kroners ($2,680).

The repairing of the roads.—Whenever the wear and tear superstructure, as on the first-class roads, is formed of a layer of hand-broken stones of 1 to 2 inches in diameter, the relaying is made as follows: Previous to the relaying, the still remaining part of the worn superstructure is scraped loose, after which the new material is laid down and leveled, and then firmly compressed with heavy rollers. It is then covered with sand gravel and again passed over some five or six times with the roller, until the road has obtained a thorough compactness. The relaying generally takes place in the autumn, in moist weather, and for the proper distribution of the work a systematic plan is prepared, and the repairs undertaken in a rotation of years on the different parts of the road, according to the extent of wear and tear variously shown. The annual supply of stone metal required for a fixed length of road will differ greatly. In the Copenhagen district, where the traffic is large, the annual consumption may amount to 123 cubic metres per 100 fathoms of roadway, whilst in the neighborhood of the more important provincial towns it will be about 80 cubic metres, and at a greater distance from the towns the consumption will fall as low as 40 cubic metres every sixth or tenth year for every 100 fathoms of road.

The public roads in Denmark, as before said, are now managed by and at the expense of the local municipal boards, subject to state supervision, as follows:

1. The highways and larger public roads are managed by the county council boards, but no works of extension or limitation can be proceeded with without the previous sanction of the home secretary. These highways have also to be inspected every year by a state inspector, who shall notify to the boards any existing wants, and should necessity arise he may order such works to be made good at the expense of the defaulting board. Each county board has also its own inspector, with assistant inspectors and roadmen, the cost of new works and repairs being borne by the county contributory fund, raised upon the taxed valuation of the land in the districts concerned. With the highways are also connected such main streets of the provincial towns as are a continuation of the road leading into the town, and these are placed under the joint control of the county council and town council boards, the expenses being defrayed by county as well as town councils, each with the half part.

2. *The by-roads.*—These are managed by the parish boards of guardians and town councils, each in its own sphere. All extensions or limitations of the by-roads are made at the recommendation of the parish

boards and with the sanction of the high sheriff and county council, and when works of more extensive nature are called for the county council can contribute their pecuniary share, the work being then performed under the direction of their own inspector.

In order that the home secretary may at all times be kept acquainted with the financial position of all matters relating to the public roads, the county council boards have to forward to the home department a yearly account, drawn up in an approved formula, of all expenses incurred on the public roads in their district. The home secretary has also the deciding of all matters in dispute relating to the roads. For this purpose the surveyor-general appointed by the state has to give his opinion on all road questions, and furthermore has to inspect yearly a certain quota part of the public highways ($\frac{1}{3}$–$\frac{1}{4}$ in each district), and at the close of every fifth year to furnish the department with a general report over the kingdom's highways and main streets for the previous 5 years' period, with statistical and financial returns appertaining thereto.

Expenses on road works.—The cost of yearly maintenance of the highways and roads does not alone depend upon the traffic or number of personal staff employed; but also on the cost of materials in the different districts. The daily repairs are made by permanent road laborers; of which in the neighborhood of a town one is generally employed to every one-half or three-fourths of a Danish mile, which proportion will be changed as by degrees one withdraws more and more into the country, when it may conclude with one road laborer to 1 Danish mile; and the daily attendance on the road may be reduced to an attendance of three days in the week. The superintendence of this work is performed by assistant inspectors to every 5 to 20 Danish miles, according to the nature of the roads. The annual cost of maintenance varies very much; for example, in the Copenhagen district, where the traffic in the immediate neighborhood of the city is exceedingly heavy, the cost of repairs may be excessive, running up to 20,000 kroners ($5,360) per Danish mile, when on the other hand in the thinly populated country districts it may not exceed 500 kroners ($134) per Danish mile; and perhaps the average annual cost of maintenance of these highways for the kingdom at large may be fairly placed at 2,000 kroners ($536) per Danish mile.

It can scarcely be said that the public roads in the present time have any effect on the land values; such may be more justly due to the great connecting railways, which have unquestionably exercised a favorable influence, especially on the value of landed property contiguous to the railway stations. The highways are no longer the great medium of conveyance for passengers and the great internal goods movements. This work is now monopolized by the great railway network of the kingdom, the highways being now more or less reduced to the position of partial feeders to this newer dominating medium of internal intercourse.

STREETS OF COPENHAGEN.

It will be sufficient to confine my remarks to those of this capital. From the latest official returns at the close of the year 1886, the area comprising the public streets, boulevards, etc., of this city was at that date about 20,100,000 square feet distributed in the following manner, namely:

	Square feet.
Carriage-ways, gutters, etc	12,000,000
Side foot-pavement	5,750,000
Planted avenues and boulevards	2,370,000
Total	20,120,000

The breadth of the streets varies greatly. In the older parts of the town very narrow streets are still to be found, whilst in the new quarters of the city the minimum regulations under the present building laws will be found to exist, namely, a breadth of 40 to 50 feet, and where the streets have a more important carriage traffic a breadth of 60 to 80 feet. The streets as a rule consist of one roadway with two side foot-pavements, and where no special conditions call for a deviation from these rules each side foot path will have a breadth of one-fifth of the entire street breadth. The roadway form is of the arch of a circle, the road on the paved ways having a fall of 1 in 30 to 1 in 40 and on the macadamized ways of 1 in 25 to 1 in 35.

The formation of the different classes of carriage-ways are as follows, viz:

THE PAVED ROADS.

Materials.—For the paving stones granite is exclusively used, of which the chief part comes from Sweden. The heads of these stones have a rectangular form with a length of 7 inches to 9 inches, breadth of 4 inches to 5 inches, and height of 7 inches to 8 inches. As between the head and root a divergence is allowed up to 1 inch in the length and breadth, and the cost of these stones per square fathom is $4.82 for first sort and $3.48 for second sort. For pavements requiring a special foundation a better class of stone is used, namely of the so-called class "English hewing." The dimensions of these are 3½ inches to 4¼ inches in breadth, 6 inches to 12 inches in length, and 6½ inches to 7 inches in height. The severer conditions demanded for this class of stones have naturally an influence at the same time upon the cost, the price of this special class being from $5.90 to $6.70 per square fathom.

Carrying out of the works.—The pavement as a rule is laid upon a sand layer 7 to 8 inches in depth; the stones being placed thereon at right angles to the direction of the street; the whole being stamped down with heavy butts worked by 4 men.

All work for laying of new pavements, as well as all relayings of any importance, is always submitted to contract by public tender.

In individual cases of much frequented thoroughfares, it has been the practice of late years to give a good foundation underneath the upper paving. This foundation in some cases consists of 4-inch to 6-inch thick layers of Portland cement; but more frequently of a bottom layer of stone laid flat side down, the whole wedged together with smaller stones. Upon this a layer of broken stones is spread, in such manner that after a pressure with heavy iron rollers, this layer will remain with a thickness of 3 inches at the sides, and of 5 inches in the center; and on this firmly rolled foundation, the paving stones are placed upon a 1-inch thick layer of gravel.

THE MACADAMISED CARRIAGE WAYS.

Materials.—For the foundation layers of granite or flint are employed, and for layers of broken stone exclusively of granite; the broken stones to be clean, well-screened, and not over $1\frac{3}{4}$ inches large.

Carrying out of the works.—The foundation stones and layers are laid in exactly the same manner as the pavement ways in the greatly frequented thoroughfares. The keeping in repair of this class of roads is for the most part done by the corporation's own work people.

THE SIDE FOOTPATHS.

In all the main thoroughfares and principal streets; these are paved with small paving flags of about 4 inches square, costing $3.75 per square fathom; whilst in the less frequented parts of the city a considerable part of the footpaths are macadamized, having a 3 inch to 4 inch thick layer of small-sized broken stone, covered over with earth gravel; the whole being well consolidated under passage of heavy iron rollers. This footpath covering has, however, in the later years been more and more displaced by tar-beton pavements. This consists of an undermost layer of untarred small stones or broken brick; thereupon of a $1\frac{1}{2}$ inches thick layer of $\frac{1}{2}$ inch tarred stones; this again with a 1 inch thick layer of $\frac{1}{4}$ inch sized tarred stones, and over the whole of a layer of tarred gravel; each layer being separately rolled over with the heavy rollers. The cost of such tar pavements when laid down may be reckoned at 5 to 6 cents per cubic foot.

The expenses entailed upon this city in laying out of new streets and sewage works, as well as for keeping in repair of the street ways, as also of closed and open drain passages, etc., in the year 1888 (the latest printed returns) amounted altogether to 1,237,400 kroners ($331,623), which was distributed in the following manner, viz:

Class A, cost of repairs of street ways, footpaths, drains, etc., watering and cleaning streets, salaries and wages, etc., $161,953.

Class B, cost of new street ways and sewerage works, $169,670.

The amount under Class A, constituting the running expenses, is included with the other municipal outlays in the annual budget of the

city to be covered from the rates levied upon the inhabitants for these purposes, whilst the amount under Class B for the undertaking of new and extraordinary works is, on the other hand, met through the aid of loans contracted by the corporation for such outlays, which loans, with the high credit of the city, can be obtained at about par rate and at an interest of 3½ per cent. per annum.

HENRY B. RYDER,
Consul.

UNITED STATES CONSULATE,
Copenhagen, April 15, 1891.

FRANCE.

REPORT BY COMMERCIAL AGENT LOOMIS, OF ST. ETIENNE.

A CENTURY OF SUCCESSFUL ROAD BUILDING.

The modern road system of France was inaugurated by the First Napoleon and carried forward to its satisfactory and splendid conclusion by the late Emperor, Napoleon the Third.

The roads of France are now practically all built, and they are substantial monuments to the Napoleonic foresight and shrewdness. The work of the engineers in the department of public works in France today is not to build new roads, except in rare instances, but to keep those already constructed in a state of high efficiency. There have been no important new roads opened in France for a dozen years, and the country is so traversed with excellent roadways that no more lines of communication are likely to be exploited save in the case of military necessity. The wagon roads of France, always passable and reaching all centers of population, no matter how small, are the chief competitors of the railways, as means of communication by water are not numerous.

VALUE OF FRENCH ROADS.

The road system of France has been of far greater value to the country as a means of raising the value of lands and of putting the small peasant proprietors in easy communication with their markets, than have the railways. It is the opinion of well-informed Frenchmen who have made a practical study of economic problems, that the superb roads of France have been one of the most steady and potent contributions to the material development and marvelous financial elasticity of the country. The far-reaching and splendidly maintained road system has distinctly favored the success of the small landed proprietors, and in their prosperity, and the ensuing distribution of wealth, lies the key to the secret of the wonderful financial vitality and solid prosperity of the French nation.

TYPICAL ROADS.

The French roads have compelled the respect and admiration of foreigners for a century, and of all the roads in the country those considered the most excellent, and at the same time most difficult of maintenance, happen to lie in this consular district, which contains in the Isere some of the most rugged of the French Alps, with their peaks forever snow clad and rising to a height of 11,000 feet.

Another department, that of the Loire, is a great industrial center, and its roads are subjected to the wear and weight of vehicles heavily laden with iron, coal, castings, and blocks of stone. It is also a partially mountainous region.

The French road engineers consider the roads in these two departments, the Loire and the Isère, as examples of the highest type of perfection to which modern road-making has reached in this country.

The roads in these departments are numerous, of easy grade, solidly built, always open and always good, save when temporarily blocked with snow. They are subjected to the most changeful and violent forces of nature. Snow, frost, ice, and furious glacial torrents springing suddenly into existence at unexpected points have sought for a decade to destroy them, but in vain.

In the high, mountainous regions of the Isère I have seen, after violent summer rain of 36 hours' duration, 50 yards of national road, including a small bridge, washed away by a fearful torrent rushing down from a cloud-capped field of ice, with an almost vertical fall of 2,000 feet. In 3 hours, and in the midst of a severe storm, I have seen that same road repaired temporarily and made passable by the road men in this remote and little frequented region.

It is this never-failing watchfulness and promptness in repairing roads, coupled with thorough and honest construction, which gives France a system of roads which is at once a source of national strength and of national pride.

From the road records of the departments of the Loire and the Isère, from recent observations and from the practical communications of the working engineers, I have condensed some information covering the principal points in the methods now employed in building and preserving French roads.

DIVISIONS AND CLASSIFICATION IN FRANCE.

In France the ways of communication are divided into three classes, as follows: First, national or state roads constructed and maintained by the state; second, department roads entirely at the charge of the departments, and, third, township roads which, though constructed by the communes, receive in most cases support either from the state or from the departments for their maintenance.

The national roads radiating from Paris communicate with all the

important cities and the departments in the country. They are placed under the jurisdiction of the ponts et chaussées (department of bridges and roads), which is attached to the bureau of the minister of public works. The second and third class of roads form a network over the country and are under the supervision, in a general way, of the prefects and mayors. However, in most departments these roads, too, are also intrusted to the care of the ponts de chaussées.

Further, there exists in towns of a certain importance a municipal road service, the business of which is to construct and maintain streets and roads within the limits of the city.

LEGAL PRELIMINARIES.

For the construction of a road two principal operations are required, viz: First, the formation of the bed of the road as well as the construction of the water ways and bridges when necessary; second, the making of the road with paving stones or by the method of Macadam in order to render it fit for traffic. When the need for a new road felt in a given district, an estimate with designs is drawn up and forwarded to headquarters, together with evidence justifying the demand. When this formality has been gone through, civil engineers go over the region, examine the direction the road is to take, draw up an exact estimate of the cost, make the specifications, and write out in detail for the benefit of the contractors their observations on the manner in which the road should be constructed.

The report of the engineers is sent to the proper authorities.

Before commencing the work the authorities proceed to acquire the necessary lands through which the road is to run and the proprietors are invited to sell the rights of way.

If a landowner demands a much higher price than the estimated value, the Government appoints a special jury to appraise the land and it is condemned on their valuation, from which there is no appeal. This act is called in France "*Acté d'expropriation*," or dispossession.

The work is then placed in the hands of the contractors, who must execute it under the supervision of the engineers and according to the stipulations of the estimate, and if any difference arises between the contractors and the engineers it is brought before the conseil de prefecture, from the decision of which body, however, an appeal can be made to the state council.

RUNNING THE LINE.

It is not necessary to go into the political, commercial, or industrial considerations which induce the Government or local administration to decide upon the creation of a road. It will be sufficient to imagine two given points which it is desired to unite by means of a new road and to mark out within these limits the best line, bearing in mind three

cardinal points, economy in the working expenses, security for the traffic, and the cost of repairs, which should be reduced to the lowest degree.

To trace a road a topographical chart is first studied in order to obtain the exact positions of the extreme points and their relation to the neighboring or intermediary points. The ground is then gone over in order to complete the information furnished by the chart and to discover other points if necessary which would be preferable in a technical or commercial point of view. These might be bridges, which could be used with advantage and thus realizing a certain saving, or in the case of a stream where the construction of a bridge presented more facilities than at the points originally indicated, or, again, certain depressions in the ground which would permit the road to pass over a hill with a lower gradient, or, lastly, where populous centers require that the proposed road should run through them.

A careful and well considered examination having been made on the main points of the line, sections of more or less length are studied so as to unite them all, finally, with more facility.

It is impossible to lay down a general and absolute rule, to obtain the best tracing between any two points. The nature of the ground and the intelligence and liability of the operator have a certain bearing on the end in view. However, a good method of avoiding grave errors and much trouble would be, trace at first upon the plan of the region between the two points a straight line uniting them; this line forms the tracing of a vertical plan in which the axis of the projected road is placed.

The next thing is to consider, first, if it would be possible to make on this plan either a uniform incline or a series of inclines, not exceeding the degree of inclination previously fixed and at an average cost; second, if this plan did not encounter material obstacles, such as swamps, mountains, or buildings, which could not be overcome without considerable expense; third, if by going to the right or left of the line it would not be possible to obtain a more gentle incline or a decrease in the expenses of the construction or both together.

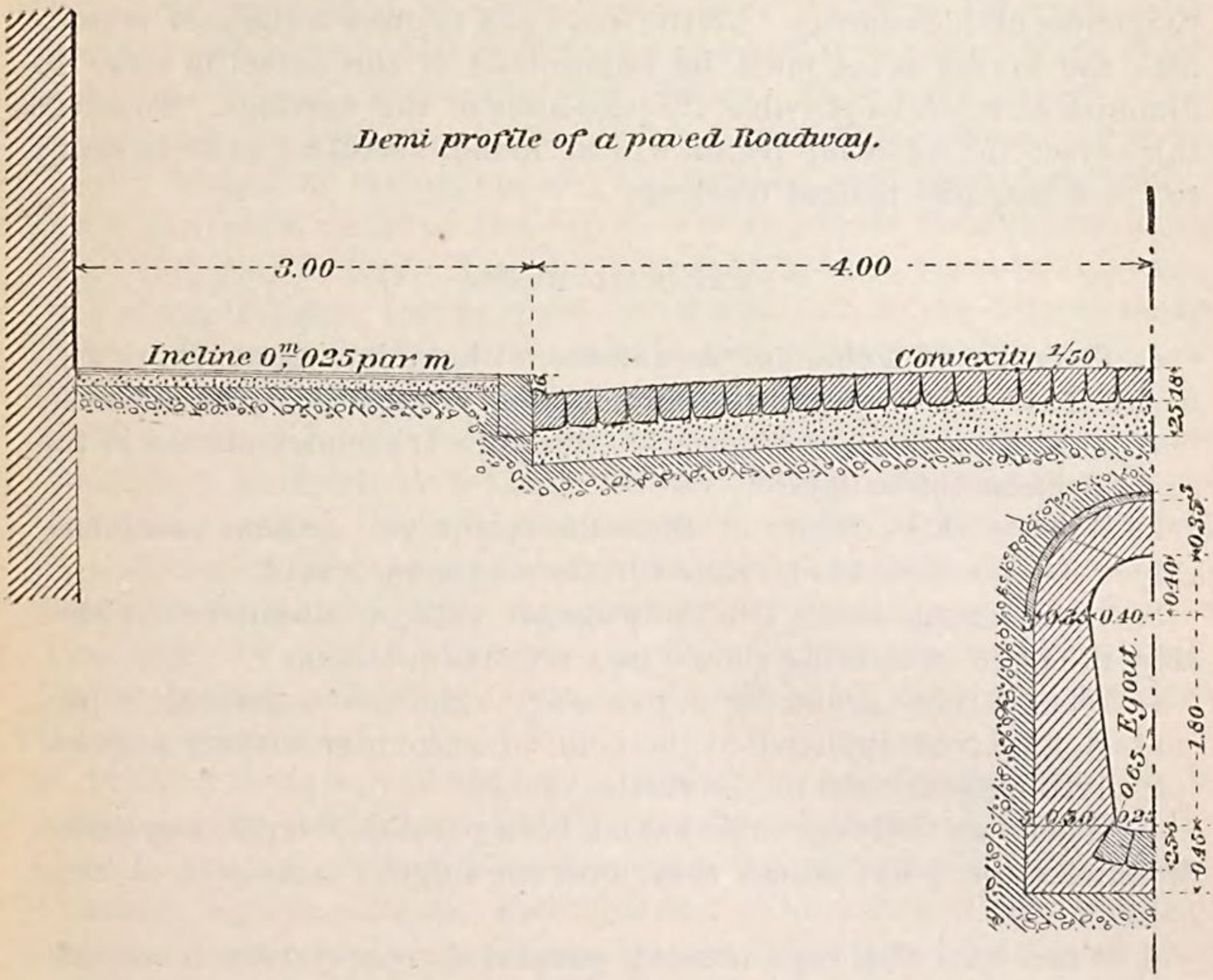
It is only in very rare and exceptional cases that a road can be advantageously traced in a direct line between the two points, even when they would be separated by a short distance. It is generally necessary to deviate in order to avoid difficulties to give the road the best position to escape heavy fillings or cuts.

EARLY DETAILS.

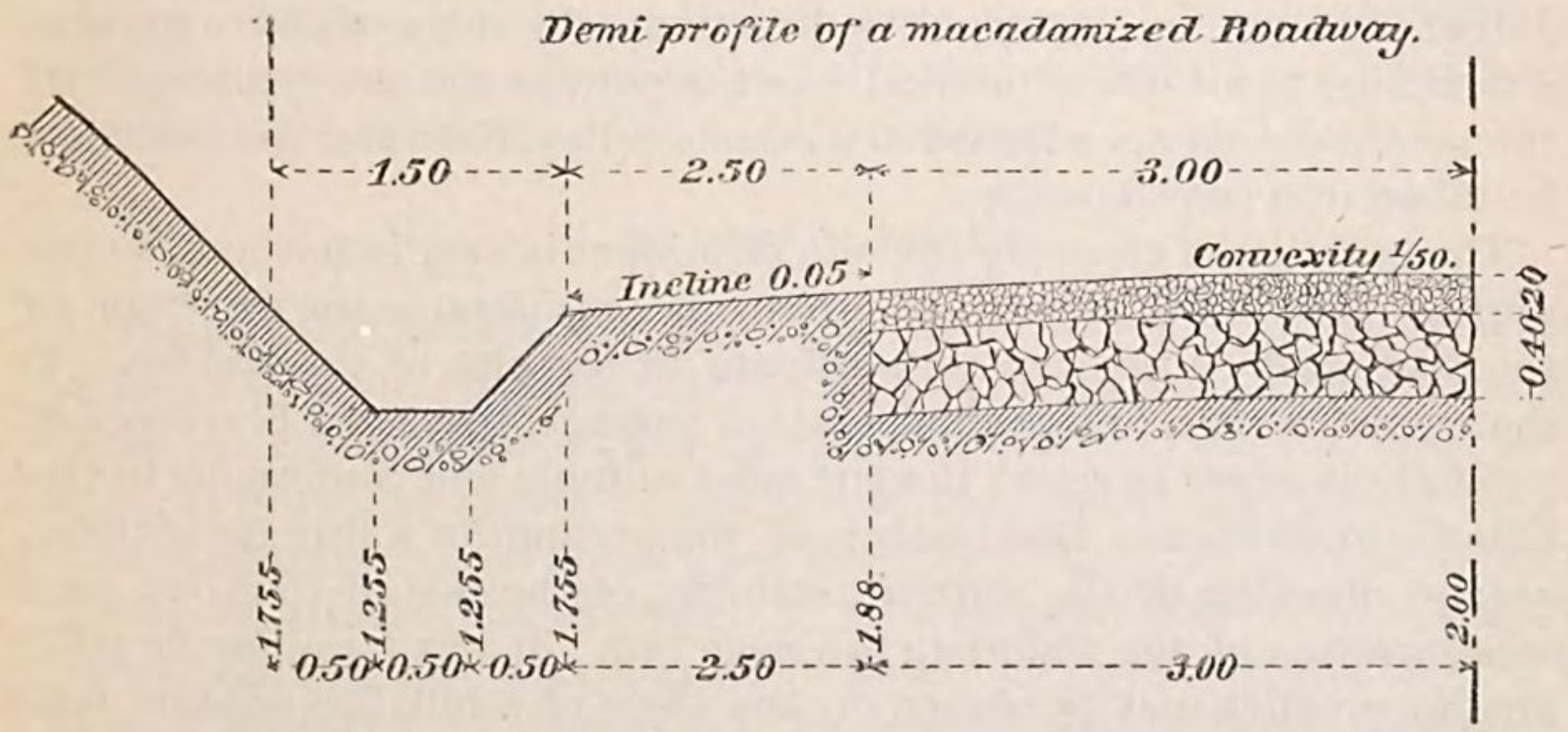
It is especially to mountainous districts that the foregoing considerations apply in deciding on the tracing of the road. The difficulties to be met with in those regions can hardly be explained in this report. It will suffice to say that the intelligence of the engineer reduces those difficulties as much as possible. The lowest points of the ridges are chosen and when possible the lines of the valleys are followed.

In general where the points intended to be united by a road are situated upon flat ground, the natural indication is the straight line, but more frequently the ground is intersected by marshes, streams, or buildings, and in that case the tracing must be modified to suit economical considerations, convenience, and solidity.

Demi profile of a paved Roadway.



Demi profile of a macadamized Roadway.



Scale 1/50 of a metre.

Where the ground is not very uneven the tracing can be made without much difficulty, but it would be well here to remark that a curved tracing lengthens but slightly a road and should be preferred to a zig-zag line.

THE ENGINEERS' WORK.

When the termini are separated by sinuosities the grades of which are greater than those previously fixed, by valleys, ridges, or mountains, the direction of the tracing is difficult to determine. A simple bird's-eye view is not sufficient; the difficulties increase with the degree of the roughness of the country. If the road has to cross a chain of mountains, the lowest point must be determined at the outset in order to diminish as much as possible the expenses of the cuttings. To effect this object the following points will be found useful as hints in order to avoid long and tedious leveling:

PRACTICAL HINTS.

1. The ridge of a chain of mountains, without having anything geometrical about it, either in the horizontal or vertical sense, is, however, looking at it in the *ensemble*, nearly straight. It inclines always in the same sense as the valleys.

2. When a ridge meets at the same point two or more secondary ridges this point should be raised to the maximum level.

3. When a ridge meets two thalwegs (or valleys) situated on either side, the point of meeting should be a relative minimum.

4. When a ridge is met by a secondary ridge and a thalweg, it presents a horizontal inflexion at the point of encounter without presenting anything particular in the vertical sense.

5. When two thalwegs after having been parallel diverge in opposite directions, the point where they meet the ridge is necessarily a minimum.

6. When two thalwegs observe paralleled courses for a certain extent, but running in opposite directions, the ridge ought to present a minimum point in the interval which separates the two thalwegs. If the points chosen are situated in the same valley, the water courses must be taken into consideration.

The question of choosing the site of bridges is very important; so important, that if the river to be crossed is considerable the direction of the road must be rendered subordinate to the site of the bridges. If there exist several practicable points of passage, they must be compared carefully in order to select the one most suitable and conforming to the following conditions: Good nature of the ground for a firm foundation, normal direction of the current, stability of the bed of the river, and concentration of the waters in the same bed. If one terminus be situated in a valley and the other on the slope of a hill, the solution will depend in a great part on the average slope of the ground between the terminal points. If this slope conforms in general to that already fixed the tracing is made in a straight line.

THE OLD WAY.

In short, if the average incline is inferior to the limit fixed several solutions are possible.

The straight line might be taken, but this tracing is not much observed to-day, for it happens more frequently that the points to be joined are separated by secondary valleys which would have to be crossed with a great deal of difficulty and inconvenience. Many of the old roads were constructed on this system. They were projected over mountains and valleys regardless of the natural obstacles of the route or the interest of the population, and as they were pushed on boldly, they were constructed at the expense of enormous trouble and never were they satisfactory. The aim supposed to be in view, the shortening of the distance, was far from being attained, as the delays arising from the up and down hill nature of the road lengthened in reality the distance much more than the curves of a level road.

Another system consists in following in a horizontal line as much as possible the ridge in its length, and descending to the second point by a gradual incline. This method was much employed formerly, and had the advantage of crossing the streams almost at their source, necessitating consequently but comparatively unimportant outlays for the crossing. But ridges which are generally sinuous require a very undulating tracing, and being but sparsely inhabited, the road loses much of its importance.

A third solution, and the one generally employed to-day, consists in following the valleys as much as possible, and rising afterwards by gentle grades. This tracing traverses the cultivated lands, regions studded with farm-houses and factories. The value of such a line of communication is much more considerable than that of a route by the ridges. The water courses which flow down to the principal thalwegs are, it is true, crossed where they are largest, and require works of large dimensions, but also they are fewer in number.

MOUNTAIN ROADS.

The terminal points may be situated on the slopes rising from the same valley, and then the shortest route would be to go down directly from one side, cross over, and ascend the other. This direction, however, is often impossible on account of the inclines being too great on either side, and would necessitate the filling up of the valley, causing thus great trouble and expense. It is much preferable to run along the side of the hill, observing a gradient and to go up on the other side in a similar manner. The valley can be crossed then without requiring a heavy embankment. But of course the length of the road is thereby much increased as well the expense of the construction.

Whenever it is necessary to unite two given points situated in different valleys separated by several small ridges the difficulties are very

great, and increase with the importance of the uneven nature of the ground. The points of passage over the ridges are first determined, always bearing in mind the probable cost, which should be as low as possible. When they are fixed upon, the outline is subdivided into different lengths and examined apart. It can be easily inferred then that the chief difficulty lies in choosing these points of passage over the ridges. Moreover, before fixing on the points of passage, it is necessary to be assured that they can be reached, for sometimes this is impossible as the hillsides are too steep.

CONSTRUCTION OF THE ROAD.

When the outline of the road is fixed upon, the profile of the length is exactly marked out as well as that of the breadth, so as to evaluate the earthworks and the works of art. The transverse profile of a road affects generally the following form:

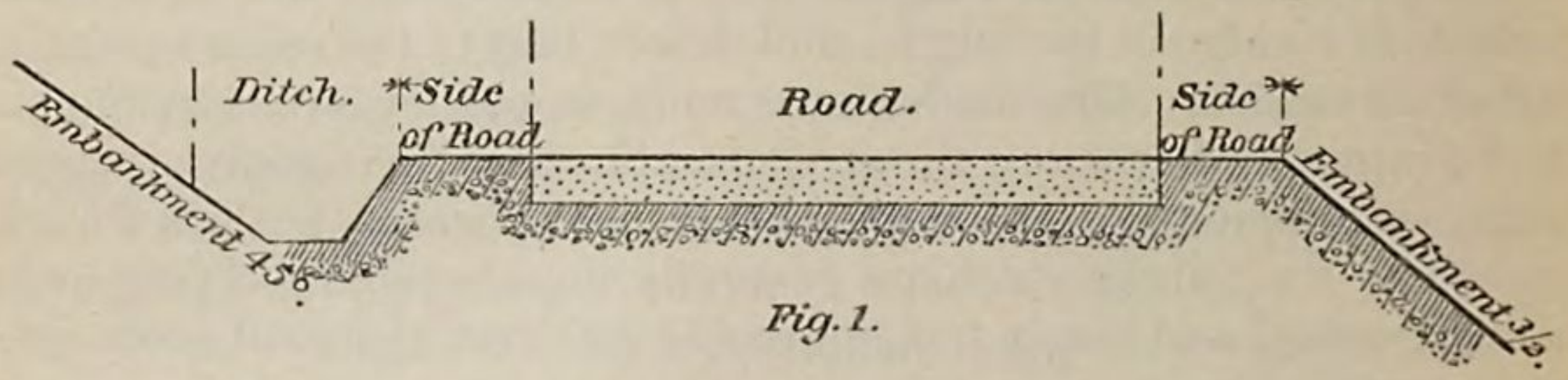


Fig. 1.

It is composed of, first, a roadway varying according to the importance of the road from 3 to 6½ yards in width, and even more in some cases, where the circulation requires it; second, the sides are also of variable width, and the ditch destined to receive the water coming from springs or rain. Sometimes a part of the sides is higher than the roadway (Fig. 2), and in that case it takes the name of footpath, and is

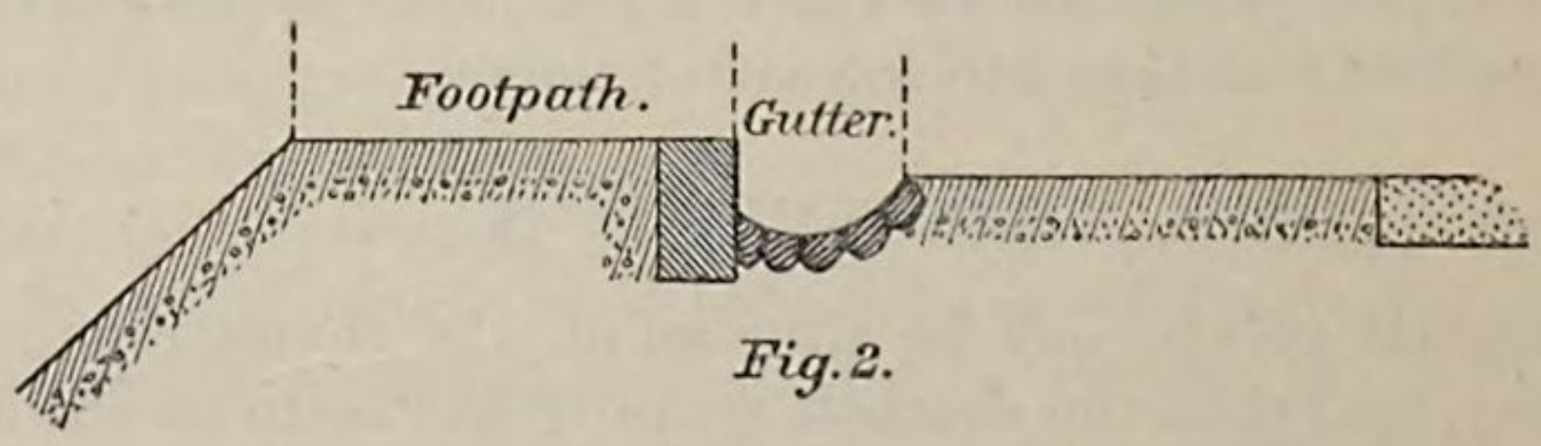


Fig. 2.

generally seen in towns, or in their neighborhood, to facilitate the circulation of the foot passengers. But in such instances it is necessary to establish a gutter to receive the waters of the street. The roadway is barrel-shaped, and the sides are sloped transversely in the proportion of one inch to the metre, to facilitate draining, the width of the ditches or gutters being in proportion to the amount of water to be received. The slopes or embankments are pitched at an angle of 45 degrees in the case of excavation. In mountainous regions a rectilinear profile is given to the road, which is inclined towards the side of the mountain especially in the curves, the convexity being on the side of the valley.

A wall confines the road on the side of the precipice, and a ditch runs along by the hill. In the case of large cuttings, the sides of the road are sometimes suppressed in order to diminish the cube of excavation.

It is not, however, always possible to construct a road on the above plan, for it often happens that the sloping of the ground is such that it would require a very large and steep embankment to cross the ravines.

In such cases the embankment is replaced by sustaining walls on either side, as shown in Fig. 3.

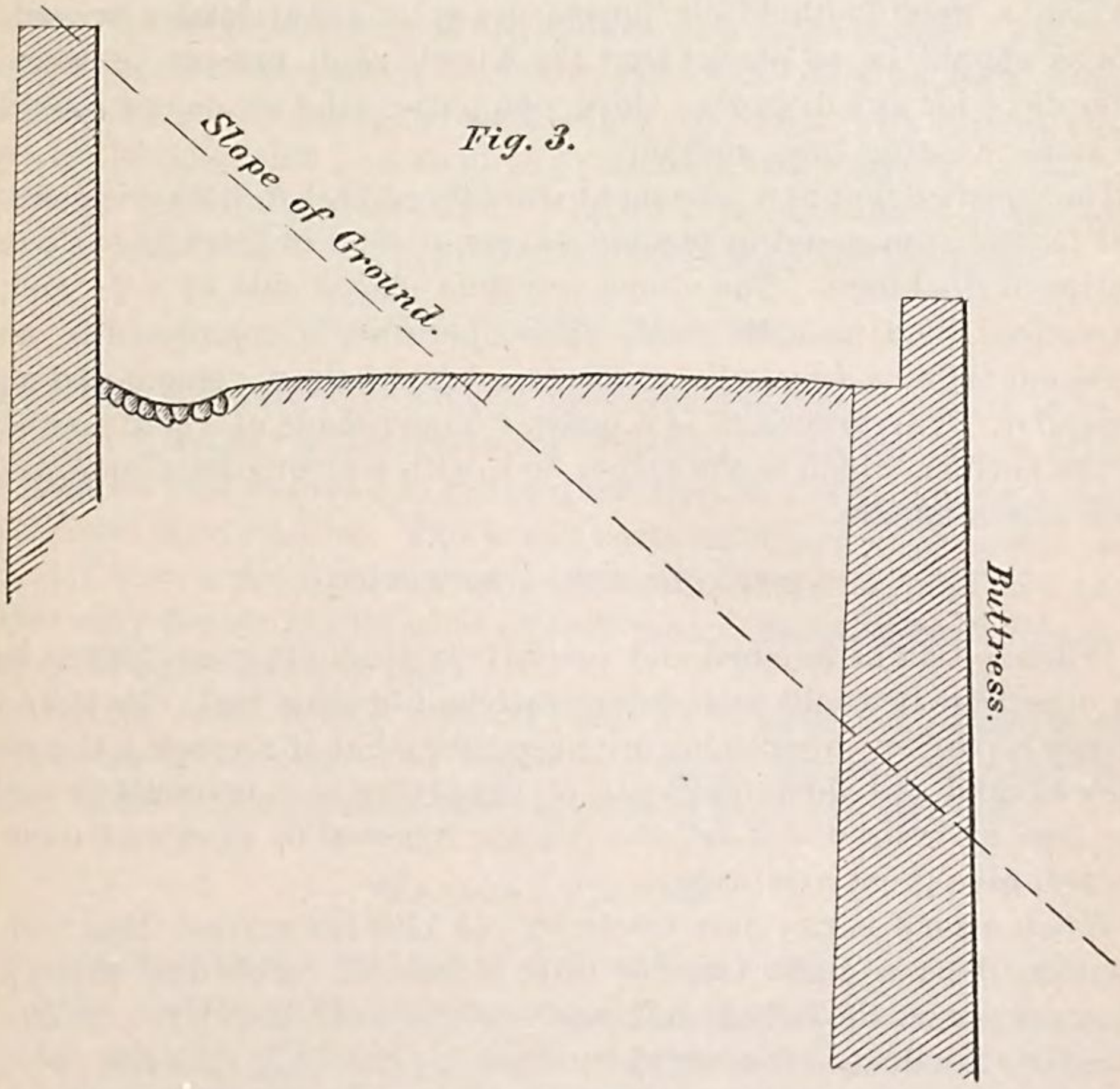


Fig. 3.

The foundation must be well laid, and the thickness sufficient to resist the weight of the soil. These walls are built wherever they cost less than the embanking process, and when the security of the traffic requires it.

The construction of a road brings often to light springs which appear at first sight harmless, but little by little they saturate the soil and end by washing it away. In such cases drainage must be rigorously applied so as to prevent inevitable consequences.

MODE OF CONSTRUCTION.

The greater part of the roads in France are macadamized; it is only in towns that paving stones are used. The layer of broken stones com-

posing the road is from 12 to 25 centimetres thick. This layer is placed directly on the beaten ground. In exceptional cases a layer of sand intervenes, or even stones of a certain magnitude, in order to facilitate the drainage. Sometimes the stones are undressed cobbles, such as are found in the beds of rivers or on the seashore, but this kind of pavement is seldom used now. The paving most generally used is made of hard granite, and laid at right angles to the axis of the road. The cuniform paving stones vary from 10 to 20 centimetres in depth; much larger ones are sometimes employed in the principal streets, however.

A good pavement should meet the following conditions: First, it must furnish a good foothold for horses drawing heavy loads; second, the stones should be so placed that the wheels shall not run between the interstices for any distance; third, one part of the pavement should not be more resisting than another.

The construction of a pavement consists at first in hollowing out the bed for the stones and in placing a layer of sand of from 15 to 25 centimetres in thickness. The stones are then placed side by side, and the interstices filled up with sand. The operation is completed by an instrument called a *demoiselle*, which drives home the pavement and makes it regular. This *demoiselle* is a heavy rammer made of wood, and bound at the bottom, which is the larger end, with a strong iron hoop, and on each side a handle.

REPAIRS AND ALTERATIONS.

When a road is finished and opened to traffic it is not left to itself, for otherwise it would soon deteriorate and become bad. To keep it in proper repair two operations are necessary, that of removing the waste, such as mud and dust, and that of supplying new material to replace the loss by wear and weather. To the removal of mud and dust the French give great attention.

When a road is run over freely by vehicles for several days and the weather is dry a slight layer of dust is formed. This dust annoys the passengers and the horses and renders the road heavy for traffic. If rain falls the dust is converted into mud, producing ruts and faults of every sort, consequently the dust must be removed, and the instrument used is the broom. A well-swept road leaves no mud after rain, at least not for several days. However, if the humidity continues the road becomes at first sticky and finally is covered with mud, which should be promptly removed, as the mud makes the tracks of the wheels apparent, and as those tracks constitute a smoother surface for running on than the rest of the route other vehicles follow in them, and after awhile regular ruts are formed, which injure greatly the road. All the while, moreover, the wear and tear continues, although slowly, and consequently at certain periods the road must be repaired. As a rule wet weather is chosen for this operation, and the principle which ought to guide the roadman in his work is the avoiding of creating a special

track in the road for traffic. The vehicles should run over any part of the surface to prevent the depressions alluded to.

THE USE OF ROLLERS.

Formerly a road was opened to traffic immediately after construction while the stones were yet loose, but the inconvenience of this method has disappeared since use has been made of heavy rollers, which compress the material. A roller, or compresser as it is called here, consists of one or two heavy cylinders drawn by horses or propelled by steam. The cylinders weigh 4 tons, but this weight is subsequently increased by filling the large box over the cylinders with large stones. The rolling machine is first passed over the road with only its own weight, that is to say empty, and gradually stones are added. In order to effect properly the operation the road is previously well watered. Constant repairing is required, especially after heavy rains, but the material being always at hand, the work is promptly executed by the roadman.

BASALT VERSUS GRANITE.

Since 1846 the French engineers have generally used basalt instead of crushed granite on the roadways which are built for heavy traffic. This basaltic rock is found in great quantities in the adjoining department of the Haute-Loire. The basalt costs $2.50 per cubic metre, and 300 cubic metres are used for each kilometre, or sixth-tenths of a mile. It is not only far better, but about 30 per cent. cheaper, than the crushed granite, formerly so much used.

The cost of constructing a paved roadway is $2.35 per square metre and the cost of keeping it in repair is 8 cents per square metre per annum, while that of a macadamized road is from 5 to 10 cents.

THE ROAD SERVICE.

The road and bridge service of France is a strong and effective organization. Responsible men are employed in it, thoroughly trained, and their work is subjected to close inspection by government engineers. No part of the road system is neglected; the routes are divided into sections of half a mile to 3 miles in length, according to the importance of the road, each of which is confided to a man or number of men, so that every foot of the roadway is inspected daily and is kept in thorough repair.

Cost of good roads in France.

Average cost of building a road per kilometre	$6,600.00
Cost of a road in the valleys per kilometre	4,000.00
a road in a mountainous region per kilometre	9,000.00
keeping in repair per kilometre and per annum	440.00
embanking per cubic metre	.18
paving streets per square metre	2.43

Cost of a road in the valleys per kilometre—Continued.

paving stones (per 1,000 stones)	$48.26
ordinary workman per day	.58
man and horse hire per day	1.55
foreman per month	20.00
supervisor of roads per annum	600.00
engineer of roads per annum	1,000.00
head engineer	2,000.00

BRIDGES.

One striking and satisfactory feature of the French road system is that furnished by the substantial and often beautiful bridges which are seen in every place where the slightest need for them exists. These bridges are generally of stone, except in some cases where large streams are to be crossed, and then the suspension system is most frequently employed with satisfactory results. However in the case of road bridges where the span exceeds a certain limit iron is supplanting stone considerably in their construction.

The French bridges, like most of the streams which they cross, "go on forever," and I have thought it well to submit some information concerning their cost. The subjoined estimates refer to small bridges only less than a hundred feet in length.

Cost of bridges of various sizes.

Nature of work.	Span.	Length.	Cost.
	Metres.	*Metres.*	
Aqueduct, roofed with flags	.60	12	$117.00
Aqueduct, roofed with cut stone	.60	13	270.00
Small bridge, arched	1	18	618.00
Do	2	15	618.00
Bridge, arched	3	10	600.00
Do	4	11	1,000.00
Do	5	10	1,200.00
Do	6	12	1,650.00
Do	10	14	5,800.00
Do	20	6	4,900.00

The foregoing figures were extracted from the official record, and show the cost of bridges of a given class now actually in use.

FRANCIS B. LOOMIS,
Commercial Agent.

ST. ETIENNE, FRANCE, *April* 23, 1891.

FRANCE.

REPORT BY CONSUL KNOWLES, OF BORDEAUX.

ROADS AND ROAD MAKING IN FRANCE.

No greater builders of roads have left their mark upon the annals of time; none have regarded them of more vital import for the maintenance and strengthening of an empire; no more forcible examples of topographical engineering have been so indelibly presented to modern generations as the great highways of the Romans.

The finest roadways existing to-day in France, the greater arteries of inland traffic, were built by the same hands that constructed the Appian Way.

If, as some philosopher has wisely observed, roads form in the material advancement of a nation a cardinal element, being in no unimportant degree essential to its development and natural resources, then we may attribute to these mighty thoroughfares of France greater distinction than has ever yet been given them.

But France, like Carthage, has suffered by her greatness.

When the Prussian forces crossed the frontier in 1870, the fine military roads (*les routes nationales*) were found more advantageous to the invaders than the invaded. The enemy profited by the master work of their aggressive neighbors. The roads afforded not only direct, but excellent routes to the French capital.

The highways of France are remarkable for their durability, evenness, and cleanliness. They are swept and watered every day, and kept in scrupulous order. No rugged eminences or depressions jar the nerves of the traveler riding over them. Neither dirt, decay, nor rubbish is about to suggest neglect or ill care. They are immense garden paths, amid a marvellous landscape of verdure and cultivation.

The process of road making in France is very simple, and their excellence is without doubt due to the simplicity of construction as well as to the superior quality of the material used.

The method is briefly thus: The materials destined for the making of roads are brought from the nearest quarries and placed at either side of the route surveyed. In order that the full amount contracted for may be delivered, the stone must be heaped in angular piles of prismatic shape and fixed dimensions. These heaps, placed at a given distance from one another, are afterward inspected by an official inspector, and must in all instances fit exactly beneath a skeleton frame carried by him. The stone is usually marble, flint stone, or gravel. The material must be of the best quality and cleansed from all foreign substances.

The stone must be broken so that each piece may pass through a ring, $2\frac{1}{2}$ inches in diameter. It is then spread evenly over the road;

the interstices being carefully filled in with smaller pieces and particles, so that the whole is smooth and free from abrupt eminences or depressions. A steam roller then crushes and further evens the whole, after which a superficial layer of clay and earth completes the work.

According to a mandate issued by the prefect of the department of the Gironde, France, the 29th of December, 1871, and approved by the minister of the interior on the 1st of January, 1872, the following resolution as to the maintenance of country and crossroads was taken.

The cost of maintaining and keeping in order of roads shall be borne by the inhabitants living in the section or district through which said country and crossroads are laid. Each taxpayer is obliged to work 3 days each year for the maintenance of the road, or has the option to pay an amount of money sufficient for or equivalent to the compensation of a laborer for a period of 3 days.

To insure faithful fulfillment of such services there is prepared in the bureau of the comptroller of taxes a schedule of taxpayers who fall under the obligations of 3 days' labor. The schedule is submitted to the director of "Direct Contributions," who, in turn, notifies each person of the 3 days he is obliged to work. The schedule sets forth, 1st: The number of members and servants in the family, the number of beasts of burden, and those used under the saddle or harness, the same being taken as a basis fortheamount of assessment. Each taxpayer is notified by the director of assessors of the number of days he is obliged to serve, or of its equivalent in money. The schedules are further posted in public places for the inspection of taxpayers, who may address any objections or complaints directly to the prefect.

The value of a single day's work is estimated as follows: Man, 2 francs; horse, 2 francs; ass, 75 centimes; cart, 1 franc; ox, 2 francs.

The services of those taxpayers who desire to fulfill their obligations in actual labor must be rendered between the first day of February and the first day of July, or between the first day of August and the thirtieth day of November. The length of labor is fixed at ten hours a day per man, and eight hours a day for beasts of burden. The taxpayer, five days before his services are required, receives orders, signed by the mayor, to present himself on such a day, at a certain place, provided with certain implements and prepared to perform certain work. If a taxpayer be prevented by illness from attending to these duties he can send a substitute to replace him, being at the same time responsible for his work.

In regard to reparations of roadways in France, the chief road inspector every year must furnish to the prefect of the department a list of the materials necessary for the making and reparation of the various highways and crossroads in the districts. The prefect gives the same to the contractor, who can not extract any materials from or open quarries except such as are officially indicated to him.

Every man who receives or makes a contract for road building or repairing must give good security, furnish certificates of capacity, and live close to the work in question. Of the moneys appropriated for the various contracts, 1 per cent. is retained by the prefect as a fund for the relief of the widows and orphans of any who may have been fatally injured in working upon the roadways.

The material used in the making and repairing of roads in France is usually the flintstone, marble, or ophite, quarried in Brittany or from the Pyrenees Mountains. The cost of this material can scarcely be estimated. In regions contiguous to the quarries roadmaking is naturally cheap. The greater the transportation, the higher the price of material carried and delivered at the proper place.

The following formula may be employed in determining the price of material:

$$X=\frac{P\,(2D+d)}{L\times C}+T$$

X represents the price to be determined; P, the price of cartage and labor; D, the distance of transportation; *d*, loading and unloading; L, traject of cart in continual motion; C, cubic measurement of the land; and T, the corresponding price of labor in loading and unloading.

The streets in the larger cities of France are, as a rule, paved with the ordinary cobble stones, resting on a 6-inch deep bed of sand and earth. The stones are quarried principally in Belgium, and vary in size from 5 by $3\frac{1}{2}$ inches in length and breadth and $4\frac{1}{2}$ in depth to $7\frac{1}{2}$ by $4\frac{1}{2}$ in length and breadth and 6 in depth.

The maintaining of the city streets and of the routes nationales of France is distinctly different than the maintenance of the roads, such as I have just described. The routes nationales, the principal roadways between the more important cities, are repaired and kept in order by the state; the expense of the same being defrayed, not by special taxation, but from the general funds. The same applies to local municipal governments regarding city streets.

I find difficulty in obtaining definite information regarding the proportionate increase in land values after the cutting through of new roads in France. That there is an increase is beyond all doubt. Exactly what it is, however, I can not determine.

Comparatively few new roads are made in the vicinity of Bordeaux, and many of the older ones date from before the Christian era. The routes of inland communication are already quite sufficient, and as the population of the French Republic is on the decrease, geographical contour remains almost unchanged.

HORACE G. KNOWLES,
Consul.

U. S. CONSULATE, *Bordeaux, January* 29, 1891.

ARRONDISSEMENT OF HAVRE.

REPORT BY CONSUL WILLIAMS.

INTRODUCTORY.

I have the honor to state that my reply to the State Department circular of November 8, 1890, entitled "Street and roadway circular," has been purposely delayed in order that I might make full personal inspection, thus making my reply as valuable as possible to whom it may concern.

In passing, and perhaps to emphasize the attention paid by me to the circular mentioned, it may be here stated that for years I have been connected with the movement in the State of New York and with its legislature to secure State action regarding the improvement of country highways in that Commonwealth as well as to an extent with like efforts in the city of Rochester.

In order to reply properly I have inspected road construction and repair in Havre and other cities of my consular district, and have journeyed into the country in company with Engineer M. Vacossin, who is trustee in charge of 435 miles of public roads of various makes and classes in the arrondissement of Havre, and thus inspected in several localities and under a variety of conditions both repair and road making.

I prepared a list of forty questions to which Engineer Vacossin made written answer, the manuscript and translation inclosed herewith; parenthetically I have added notes to the translation and reductions of metric units for the reader's benefit. Certain conclusions from my inspection here, and as modified by my experience, are subjoined.

FRENCH VS. AMERICAN ROADS.

New roads here are, if of block stone, made substantially the same as in the American cities and as outlined in my inclosures; if of broken stone, are made by first grading and draining, then spreading on a 7-inch coating of broken stone, rolling with heavy rollers, and, finally, sprinkling thickly a binding of sand, clay, or soil, which, rolled down and somewhat rolled in, forms the bearing surface; but such a coating would neither withstand the sharp pressure of loaded wagons having narrow tires nor the upheaval of the usual frosts of the Northern American winter.

The American pavements are very much better constructed than are those of France, all classes being considered. They, however, become destroyed in a short time, while those of France increase in excellence with age, until the difference is very marked. These differences arise from neglect with our authorities to promptly and properly repair and from the constant damage inflicted by the narrow tires of freighting vehicles.

In France all roads have perpetual attention. If, from weight of load, from rain, or other cause, a hollow, rut, or sink is formed, it at once receives attention, its surface usually roughened by picking, so that new material will adhere, and then the depression filled slightly, rounding with broken stone or stone chips. If the space repaired be of limited area, the rolling of the new coating is left to the wide tires of the heavy carts, but, with extended areas, a steam-roller is brought for use.

If a broad economy should be followed with the objective to make the highways of the United States like those of France, the first labor should be given to establish easy grades by cutting hills and filling valleys. This once done is forever done, and no road should be made until a grade not greater than 1 in 20 should be made, for to change the grade of an improved road makes waste of all the expense before incurred in its making. Thus grading is economy's first law, and is here the engineer's primary act.

The next step is to reduce the water evil to a minimum by either center blind ditch or side open ditches, or both, both especially in low sections and in springy soils, with capacious bridges and culverts of most durable material.

Then, having proper grade on a line free from water, less material and that of a less expensive kind can be properly used, and gravel rolled by wagon tires regulated as to width will do much to make a road.

Every freighting and market cart here is a road-maker. Its tire is from 3 to 10 inches in width, usually from 4 to 6, and so rolls the road.

With the few four-wheeled freight vehicles used the tires are rarely less than 6 inches, and the rear axle is about 14 inches longer than the fore, so that the rear or hind wheels run in a line about an inch outside of the line rolled by the fore-wheels; thus with a 6-inch tire 2 feet of road width is well rolled by every passing wagon.

The varied gauge is also usually observed with cabs, hacks, and other four-wheeled vehicles, so that they become road-makers instead of rut-makers, as in our country.

The narrow-tired wagon rides more smoothly over a bad road because its narrower pressure levels obstacles rather than surmounts them, while the wide tire, having less proportional leveling force, surmounts and creates the jolt; but just in the proportion that obstacles become leveled and road smoothed, as by the roller service of wide tires, the jolt disappears, and with such wheels on even an uncoated country road its bed, if kept rounded, soon becomes a watershed not likely to be materially softened by surface waters, while if to the surface a coating of gravel or stone chips be added and rolled the water is excluded, so that damage by winter's frosts becomes minimized and on firm soils even neutralized.

The cost of prepared material and of all labor, both for making and maintaining a road, in the United States is considerably more than double the like cost in France, but labor here is less active and efficient.

Then a road made as a pavement of broken stone, to withstand the frosts prevalent in all the United States north of about the latitude of Baltimore, must be at least twice the depth and constructed with twice the quantity of material as here, with proportionate outlay for labor; hence, allowing three elements of increase of cost in our Northern States above cost in France, of, first, double cost of labor; second, double cost of material delivered ready for use, and third, double depth or strength of road in order to resist frost and to resist the almost wedge-like tires of American wagons, and you have a fairly accurate estimate that a road after the French fashion, and made in our country so as to serve as durably there as roads serve here, will cost 2 by 2 by 2, or 8 times the cost here.

I am aware that such a report has little in it to encourage our making of good roads, but Europe has been centuries making hers, and in France frosts are trifling when contrasted with those which heave and destroy our roads every winter and spring; and the excellence of Europe's roads, as I learn, ranks in a graded scale from the frost latitudes southwards, those of Britain, Sweden, and Russia bearing no favorable comparison with those further south.

Then again the dense and old settlement of Europe, whereby farm ponds are so located as to catch surface water, ditches made and gutters paved to prevent damage by floods, and every spring confined and utilized, vastly tends to prevent the destruction of roads, for in the main water is the sole destroyer of American highways, and the owners of abutting lands instead of confining all water for farm and other uses, turn it, if possible, into the highway, where it flows unrestrained and by permeation softens every roadway, and often by its violence undermines and sweeps away portions of the roadbed.

Inclosures A and B are questions propounded by me and answered by Engineer Vacossin, of this arrondissement, while inclosures C D and E are digests of my own observations on roads and roadways.

OSCAR F. WILLIAMS,
Consul.

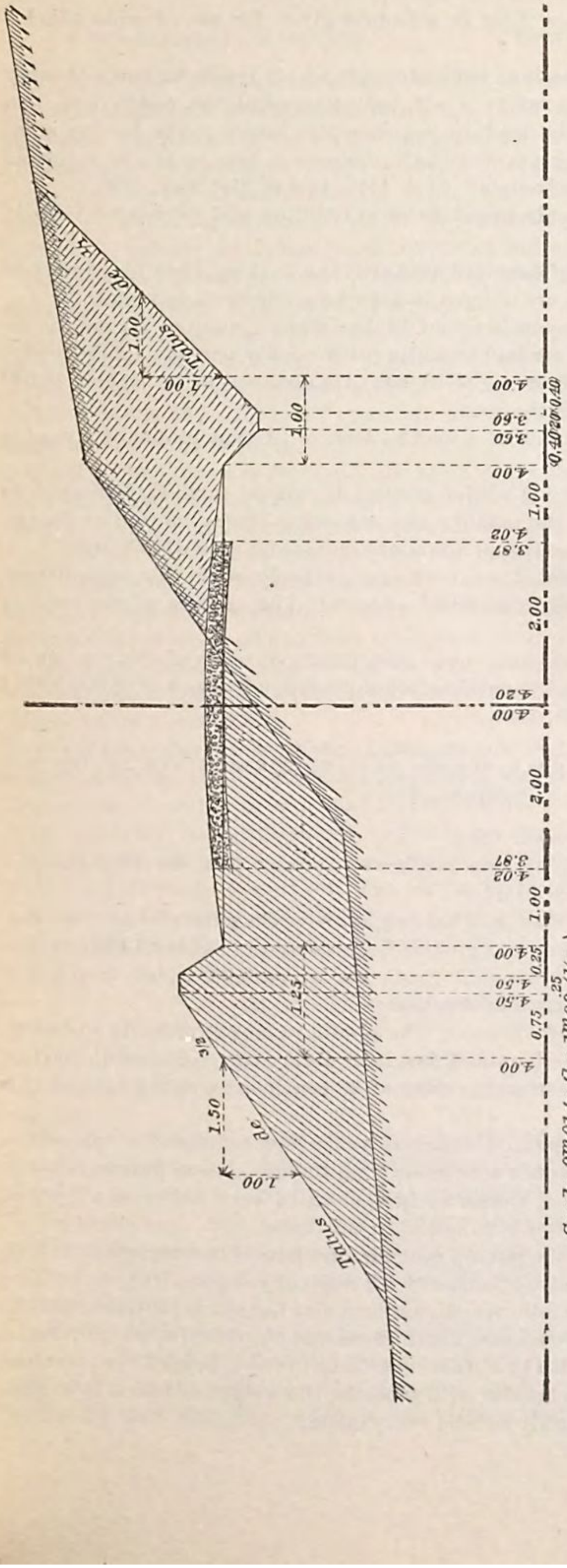
UNITED STATES CONSULATE,
Havre, May 29, 1891.

ROAD MAKING IN THE ARRONDISSEMENT OF HAVRE.

[Five inclosures in Consul Williams' report, A, B, C, D, and E, viz: A, general questions and answers as to roads; B, preparation of road before placing thereon any paving materials; C, considerations in road making; D, considerations in road keeping; E, general considerations of roads.]

A.—GENERAL QUESTIONS AND ANSWERS.

(1) Do the frosts of winter heave up and destroy your roads?—Answer. Rarely; however, every winter the frost does some damage on roads to a depth of about 15 centimetres (5.9 inches), especially in the parts where the subsoil is of a clayey nature.


Talus
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0.20
0.40
Scale 0m01 to the 1m00 (1/100)

(2) What are the legal requirements, if any, as to width of tires?—Answer. Since 1853 such regulation has been set aside.

(3) Does the weight of cart, truck, or load change the requirement as to width of tire?—Answer. Such regulations were set aside in 1853.

(4) Is there a tax upon narrow tires or a bounty given for use of wide ones?—Answer. No tax; no bounty.

(5) Are all people and occupations permitted use of all roads for loads of every weight at all times and without tax? If not, indicate exceptions, restrictions, and tax.—Answer. Restrictions can be made to regulate the use of roads having great declivity or imperfect lines; for extraordinary damage a fine or tax is collected which goes toward the expense of repair. (Art. 14th, law of 21st May, 1886.)

(6) Are owners of abutting lands taxed for road building and repairs?—Answer. No.

(9) Are country roads swept of dust and mud or is the dust removed by winds and rains?—Answer. The road men are obliged to take away the dust and mud.

(10) At what distances apart are heaps of broken stone deposited for use in repairs?—Answer. The materials are laid according to necessity per lots, 1 cubit metre (1,308 cubic yards) alternately from right to left at a distance of 50 metres (9,942 rods), and outside of the lines of the road.

(11) Will you supply me a profile of a road?—Answer. A type profile of a road is hereto annexed. (An inclosure.)

(12) Supply me, if convenient, with brief general directions such as furnished to your under-directors as guides in making and repairing roads, as well as for the preparation of the materials therefor.—(Not answered except as within.)

(13) After a new road is completed is it ever again entirely made new, or is it perpetually maintained by repair of its surface?—Answer. The surface of the road is constantly kept in repair.

(14) For what average time in years have the principal roads of this portion of France been kept up by means of scientific state supervision?—Answer. Since 1836; application of the law of May 21, 1836.

B.—Preparation of line of road before placing thereon any paving materials, etc.

(A) Is it center-drained?—Answer. No.

(B) Is it drained other than by side ditches?—Answer. Yes, for departmental roads; the communal roads have no ditch.

(C) Is the center arched, and if so, to what height above the gutter?—Answer. No.

(D) What is the usual width between gutters?—Answer. Six metres (19.68 feet) for the departmental roads. The communal roads are of variable width, from 4 to 6 metres (13.12 to 19.68 feet) exclusive of ditches.

(E) What incline is allowable?—Answer. The profile in length presents no declivity above 5 centimetres per metre (equals 1 foot in 20 feet); the width profile having the form of an arc of a circle given a convexity of 13 centimetres at the axle, so 1 in 31 of the width.

(F) Is more than one sort of paving material used; how combined or placed?—Answer. Generally the paving stones used come from the quarries of May St. Valeny en Caux or Cherbourg; the paving stones are laid close to each other on a layer of sand 15 to 20 centimetres (5.904 to 7.872 inches) in thickness.

(G) What is the thickness of the paving coating, and how is it compressed and to what weight per square centimetre of contact with roller or compress?--Answer. The paving stones have generally the followingdimensions, viz: Length 24 centimetres (9.45 inches), width 17 centimetres (6.69 inches), depth 18 centimetres (7.08 inches); or, length 20 centimetres (7.87 inches), width 13 centimetres (5.12 inches), depth 18 centimetres (7.08 inches). The pavement is leveled with a beetle, the weight of which is 30 kilograms (66 pounds) and which firmly imbeds every stone.

(H) What is the cost per cubic metre (1.308 cubic yards) of excavating soil for new roads?—Answer. For digging, shoveling out, and loading the average is 50 centimes (10 cents) per cubic metre (1.308 cubic yards). The transport expenses are calculated by the following formulæ:

$$\text{Wheelbarrow}: \times = \frac{2\text{-}p.\ d}{\text{C D}} \qquad \text{Cartload}: \times = \frac{\text{P}^1\ (2\ d + l)}{\text{C}^1\ \text{D}^1}$$

Wheelbarrow: P = price of a day's work; d = transport distance; C = cubical load ($\frac{1}{25}$ cubic metre); D = distance to run with wheelbarrow loaded half way and empty half way. Cartload: P^1 = hire of cart and driver; d = transport distance; l = distance 600 to 800 metres (119.304 to 157.072 rods), according to time lost in loading and unloading; C^1 = cubical load .7 to .8 cubic metre (.9156 to 1.0464 cubic yards) for one horse, according to the nature of the material; P^1 = distance to run with the cart during one day and when loaded half way and unloaded half way.

(I) What is the cost per cubic metre (1.308 cubic yards) of breaking stone to suitable size?—Answer. 1.75 francs (34 cents).

(J) What is the cost of the broken stone per cubic metre (1.308 cubic yards) placed on the new road?—Answer. 20 centimes (4 cents) for placing in the prepared form without roller. (NOTE.—Question evidently not fully understood.)

(K) What is the variety of stone so used?—Answer. Country flint, or the sandstone of May or Cherbourg.

(L) To what size is it broken? If more sizes than one are used, give extreme sizes and proportions of each as used.—Answer. Uniform size, the minimum 4 centimetres; the maximum 7 centimetres (that is about $1\frac{1}{2}$ inches and $2\frac{3}{4}$ inches).

(M) What material is used to bind the broken stone, and in what manner and when is such binding material supplied?—Answer. Clay, sand, or earth from the excavation when such is suitable. These materials are put on after the steam-roller has been once over the road and then continued until complete aggregation.

(N) What wages are paid per day to common laborers employed in road making, and how many hours constitute a day's work?—Answer. Three and a half francs (68 cents) for 10 hours' labor.

(O) What is the total cost per kilometre (198.84 rods) of a section of new country road?—Answer. Twelve thousand francs (per kilometre) for all sorts of work which concern the establishing of a road like the type profile hereunto annexed. (NOTE.—This equals $70\frac{1}{2}$ cents per lineal foot; $11.64 per lineal rod; $3,725.64 per lineal mile.)

(P) What is the average total cost of such a completed new road per square metre (1.196 square yards)?—Answer. The above price is to a minimum of 8,000 metres (square per kilometre of road distance) and gives 1.50 francs (39 cents) per square metre. (NOTE.—This equals $7.32 per square rod.)

(Q) *Management of road when completed, etc.*

(*a*) For what length of time after completion is such new road permitted to be used without repair?—Answer. The roads are immediately put under constant supervision.

(*b*) In what manner is its cost paid; by whom?—Answer. The cost of the departmental roads is paid with part of the communal budget united with the departmental subsidy (approved budget by the general council).

The communal roads are paid for from an appropriation from taxes collected in the locality. (Approved budget by the municipal council.)

(*c*) In what manner are repairs paid; by whom?—Answer. The same answer as paragraph (*b*).

(*d*) What is the average annual cost for repairs of such a road per square metre?—Answer. Departmental roads, in country, 10 centimes (2 cents); in town, 17 centimes ($3\frac{2}{3}$ cents); communal roads, 6 centimes ($1\frac{1}{3}$ cents). These prices include sweeping, removing mud, watering materials, and the maintenance of all works. (NOTE.—Aver-

age yearly expense of repair equals departmental roads. In country, $248.48. In town, $422.41. Communal roads, $149.09 per mile of road the width as considered.)

(*e*) What length of such road can one man keep in repair throughout the entire year?—Answer. Departmental roads, 4,000 metres (2.485 miles). Communal roads, 8,000 metres (4.97 miles).

(*f*) What yearly wages does such a man receive, he boarding himself?—Answer. The road men are employed 10 months per year, at an annual salary of 650 francs ($125.45).

(*g*) How many hours per day does he work?—Answer. Ten hours' labor.

(*h*) How many days of the year does he actually work on the road?—Answer. Two hundred and fifty days of labor (two months' leave of absence during harvest time).

(*i*) In what manner are the road engineers, su perintendents, assistants, and workmen chosen?—Answer. The engineers, agents, clerks, etc., are chosen by competition. The road men and superintendents are generally chosen from among countrymen who know all about this kind of work.

(*j*) How much are they severally paid, how long do they serve, and by whom are they paid?—Answer. *The service organization.* One chief trustee of roads to the chief town of the department; one trustee of roads to the chief town of the neighborhood; one trustee of roads to the principal district of the neighborhood; one brigadier per brigade of ten roadmen to superintend 40 kilometres (24.8548 miles) of road. This gang has to do all that is required for the communal roads. The employed are paid from funds explained above. Salaries are as follows, viz: Chief trustee of roads, yearly salary is 10,000 francs ($1,930); trustees of roads, neighborhood, salary 5,000 francs ($965) per year; trustee of roads of district, 2,000 to 3,200 francs ($386 to $617.60) per year; employés, agents, 1,200 to 1,800 francs ($231.60 to $347.40) per year; chief road men, 900 francs ($173.70) per year. Indemnity of residence and office expenses are paid according to the importance of the locality. The employed have a pension after 30 years of service.

C.—Considerations in road making.

(1) The perpetual advantage of an easy grade should be secured at the beginning.

(2) Straight lines are best and on like grades are cheapest; it is economy, however, to secure easy grades at the expense of straight lines where such grade is otherwise unobtainable, because the perpetual advantage to all users of the road more than offsets the disadvantage to the land owner from ill-shapen fields.

(3) Capacious middle blind drains in all roads will dry the soil in summer and minimize the damage by frost in winter.

(4) Side drains should never be omitted.

(5) If natural soil of road be arched at center its drainage will be easier.

(6) All stones liable to disintegrate the road surface should be rejected.

(7) Comparatively large cost is unavoidable; cheaply made roads will prove the most expensive roads.

(8) Material should be carefully selected, durability and cheapness when prepared being first considered; then by using local stone local labor may be employed, and so by outlay for stone and labor each locality will to an extent be benefited directly by the distribution of the money cost of the road in such locality.

(9) The common field bowlder, more or less a nuisance on American farms, is of a strength and durability equal to the average quarry stone; both its purchase and removal would benefit the farmer and its preparation would benefit the local laborer, and thus go far to reconcile both to the expense of the improved road.

(10) Every county should own and operate at least one steam road-roller.

(11) Road sweepings, except manure, and common sand and clay make suitable binding material over broken stone.

(12) In making a new road wetting down or sprinkling has been proven injurious; such practice is wise in repair, as then the binding material is solidified while the water does not penetrate the surface coating to soften or weaken it.

D.—Considerations in road keeping.

(1) Repair should never be delayed.

(2) Scientific supervision is essential.

(3) Wetting down aids repair by helping the new added material to adhere to the old.

(4) For repair, especially of large areas, as well as for construction, a steam roller effects great economy.

(5) The use of wide tires should be encouraged either by bounty on such or by tax on narrow ones.

(6) Four-wheeled freighting vehicles should not track; the hind wheels should roll outside the track of the fore wheels.

(7) Local tax for maintenance tends to prevent local misuse, promotes local supervision, and prompts repair.

(8) Our people may, in order to equitably adjust cost of road, fix a tax upon their use so that he who drives much and owns little assessed property may pay a just share for the road he uses.

E.—General considerations of roads.

(1) Increase of railroad mileage seems to lessen local interest in highways, but it should not be forgotten that nearly all railroad freight has been previously carted over highways.

(2) As steam road engines become more in vogue, roads and bridges should be strengthened accordingly.

(3) As bicycles and other "wheels" become used by business men, roads should be fitted therefor to every reasonable extent.

(4) The use of springs on freight wagons greatly diminishes the jolt or falling force in road depressions, prevents ruts, and preserves roads.

(5) The effects of wheels of large diameter and width of tire is to greatly diminish spot pressure, and the breaking of the road surface is thus obviated.

(6) The reduction of cost of transit of persons and freight by lower prices for liveries and for hauling would be beneficial, and as transportation is a large element of cost to every one not a producer, good roads would much cheapen living.

(7) The cost of transporting products or of hauling to market is by tenfold the highest tax now paid by our farmers and hucksters.

(8) The cost of highway transportation over the properly built roads of France does not exceed one-third the like expense in the United States, it being common in the rural districts of France to haul 3 tons, and in the cities from 3 to 5 tons, net freight, with one horse.

(9) In this way the good road saves the farmer each year much more than its cost, and we may ignore the increased pleasure in its use.

(10) If 2 horses haul the load of 4, 1 wagon of 2, 1 set of harness of 2, 1 driver serve for 2, and if 6 miles instead of 3 be passed per hour, the aggregate saving would double the net income of the average huckster or farmer.

(11) Land values are increased by improved roads. This effects 1st, increased assessment and taxes on lands abutting because most benefited. 2d. This increased assessment reduces per cent. of tax and tax on lands not abutting, and which are hence less benefited.

BOUCHES-DU-RHÔNE.

REPORT BY CONSUL TRAIL, OF MARSEILLES.

HISTORY OF FRENCH PUBLIC ROADS.

The history of public roads in France dates back to the Roman occupation. So solidly did the Romans construct them that parts of a few of them are still to be found in a good state of preservation. They were made by the Roman generals to facilitate the rapid movement of their large armies. Thus the first roads made in France were for military purposes solely, and this object has never been lost sight of; so that, although in modern times their use as the means of communication for the people accounts for their great and increasing number, it is largely owing to their military character that the French Government expends the enormous sums it does yearly on the national roads.

After the Romans were driven out of France there is nothing to note on the subject of roads until the time of Louis XIV. This monarch had several fine roads made in the environs of Paris for his personal use and pleasure. They were very wide, probably so laid out from simple ostentation, and paved only in the center for the royal coaches. Shortly after the construction of these royal roads the nation began to appreciate the advantage of paved ways, as the use of vehicles was becoming more general, and the commencement was then begun by the French people of the magnificent network of public roads now to be seen covering the whole of France, and not equaled by any other country in the world. The roads of Louis XIV were made for the king by means of the corvées exacted from the peasants. At the present time they are for the peasants by means of subsidies and heavy taxes exacted from the government and the public. The corvée has degenerated into the three days of prestation. At the present time the public-road system in France is a luxury which the people can ill afford; but the peasant who derives the greatest benefit from it uses his political influence not only to see that the roads already made are maintained, but to cause the construction of new ones that are little needed.

There are five classes of French public roads: (1) The national highways; (2) the departmental highways; (3) the chemins vicinaux (country roads) de grande communication, maintained by the department under the direction of the conseil-général; (4) the chemins vicinaux d'interêt commun, maintained by the group of communes interested, and (5) the chemins vicinaux ordinaires, at the charge of each commune.

The highways are under the general control of the department of public works, which has an agent voyer in each department (state) to superintend all that concerns roads and bridges.

The five classes of roads finished in 1867 had a length of 323,400 kilometres, and of unfinished roads there were 281,100 kilometres.

The average outlay or first cost per kilometre for these roads was: for those of the first class, 20,000 francs; second class, 15,000 francs; third class, 10,000 francs; 4th class, 5,500 francs; fifth class, 4,000 francs; and the average cost of maintenance per annum per kilometre for the five classes was, for the first class, 600 francs; second class, 450 francs; third class, 306 francs; fourth class, 190 francs; fifth class, 140 francs.

So much for France at large. Three notes are added concerning the subject in the department des Bouches-du-Rhône, and three sectional drawings of roads in different parts of France.

DEPARTMENT DES BONCHFS-DU-RHÔNE.

The Department des Bouches-du-Rhône is about the size of the State of Delaware, with a population of 604,857. More than half this number, 376,143, are in the city of Marseilles. The population of Delaware is about 168,000, and of this number 43,000 are in Wilmington. The density of population for the Bouches-du-Rhône is 119 to the square kilometre, while that of Delaware is 32 to the square kilometre.

The annual expenditure for maintaining the highways and country roads in the Department is $456,000. This does not include the streets of Marseilles. It would be interesting to know the annual expenditure of Delaware on roads.

According to Adolphe Joanne there were in 1886 in the Department 4,329 kilometres as means of communication, to wit:

	Kilometres.
17 lines of railway	413
5 national highways	284
20 departmental highways	410
Country roads:	
Chemins vicinaux de grande communication	878½
Chemins d'intérêt commun	850
Chemins vicinaux ordinaires	1,352½
1 navigable river (Rhône)	85
3 canals for navigation	56

COUNTRY ROADS.*

In the Bouches-du-Rhône, as in all the departments of France, there are, besides the national and department highways, country or village roads, divided into three classes according to their importance: (1) Les chemins de grande communication; (2) les chemins d'intérêt commun; (3) les chemins vicinaux ordinaires ou de petite communication.

All these roads are made with layers of stone broken very small after the formula of MacAdam, and maintained by the application of new beds of broken limestone. The level of the roadbed is kept up by the constant use of the same material in filling in the unevennesses or irregularities that occur.

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* The information in regard to country roads was kindly given to me by the prefect of this department.—C. B. T.

The road superintendents make the necessary repairs and look after the materials to be employed. The section of road that each one has under his charge varies in length according to the importance of the road from 5 to 10 kilometres (or from nearly 3 miles to 6½ miles).

Generally speaking the roads are made and maintained with the materials nearest at hand, and of these limestone is preferred.

The cost of road making in the Bouches-du-Rhône is on the average per linear yard, for les chemins de grande communication, 10 francs; les chemins d'inétrêt commun, 8 francs; les chemins de petite communication, 6 francs, 50 centimes.

The chemins de grande communication have a total length of 1,108 kilometres 140 metres (or about 700 miles), of which 999 kilometres 977 metres are in a perfect condition, and 108 kilometres 163 metres open for travel, but work on them not completed. They necessitate an annual outlay of 578,000 francs ($115,600), or 52 centimes (10 cents) per linear metre.

The chemins d'intérêt commun have a total length of 944 kilometres 468 metres, of which 756 kilometres 259 metres are in perfect condition, and 188 kilometres 209 metres open for travel, but work on them not completed. Their maintenance causes an annual expenditure of 256,500 francs, or 27 centimes (5 cents) per linear metre.

The chemins de petite communication have a total length of 1,012 kilometres 413 metres, of which 342 kilometres 442 metres are in perfect condition, and 669 kilometres 971 metres open for travel, but not completed. On these the sum of 351,800 francs is annually expended, or 34 centimes (7 cents) per linear metre. The commune of Marseilles alone expends on the chemins de petite communication 250,000 francs per annum.

It is certain that the effect of improved public roads has been to increase land values; but from the lack of statistics on this subject, there is no way of estimating just what this increased value may be.

The chemins vicinaux de grande communication and those of intérêt commun are made with the communal funds and the department subsidies, and in certain cases the national government also subsidizes these roads. The making of the chemins de petite communication is left to the charge of the communes, which are authorized to impose an extra tax of 3 centimes for this purpose to the principal of the four direct taxes.* The government and department also subsidize these roads.

As for their maintenance, this is provided for with special funds voted by the communes and the department. The department imposes an extra tax of 7 centimes to the four direct taxes, and the communes

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*The four direct taxes: Les quatre contributions directes, savoir; la contribution foncière; la contribution des portes et fenêtres; la contribution personnelle-mobilière; et la contribution des patentes.

5 centimes and 3 days of prestation.* The maintenance of the chemins de grande communication et d'intérêt commune absorbs the 7 centimes from the department, two-thirds of the 5 centimes from the commune, and 2 days of prestation. This leaves for the chemins de petite communication one-third of the 5 centimes from the commune and 1 day of prestation.

HIGHWAYS.†

In the Bouches-du-Rhône the highways are paved or macadamized. Paving is used only where the traffic is very heavy or where the macadam would be difficult to keep in good condition and, consequently, too onerous. In some sections where the winds are very violent, the macadam has been found to be very objectionable on account of the dust and its wearing away rapidly when subjected to violent winds that blow continually for a certain length of time.

The paving is maintained in one of two ways. When the defect is only a slight one it is remedied by simply picking out a few blocks, releveling the bed, and resetting the same blocks; but when the damage is considerable and the road has been worn into ruts from rough and heavy use, the entire defective section is taken up and repaved with the same care given the original paving.

The macadam is maintained by constantly filling up any slight depression with the small broken stone in order to keep the level and to favor the regular use of the road. When the road is worn down quite thin an entirely new bed of stone is spread over it and pressed down and worked in by means of heavy rollers.

In the Bouches-du-Rhône the national highways have a length of 283 kilometres 848 metres. Over these pass daily, on an average, 688 horses. The annual expense for their maintenance amounts to 702,120 francs. The department highways are 413 kilometres 174 metres in length, and the daily travel on them amounts to 232 horses, and for their maintenance 391,470 francs are expended annually.

These highways are kept up by means of funds provided for in the budgets of the national government and the department. There is no prestation for these highways as there is for the country roads.

STREETS OF MARSEILLES.‡

In Marseilles the streets in which the traffic is heavy are paved with porphyry from the quarries of St. Raphaël, situated about a hundred miles to the east of Marseilles. This stone forms a very hard pavement that resists wear very well, but it has the inconvenience of becoming very

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* Prestation: The 3 days of work on the roads that every proprietor, farmer, etc., is required to give free.—C. B. T.

† From information kindly supplied by the prefect of the Department of Bouches-du-Rhône.—C. B. T.

‡ From information kindly supplied by the mayor of Marseilles.—C. B. T.

smooth and slippery with constant use, and this can only be obviated to a small extent by using small stones, *i. e.*, cutting the squares down to small dimensions, in order to have numerous joints.

The streets in which traffic is light are paved with a stone called "Grés de la Ciotat," a hard kind of sandstone from the quarries of La Ciotat, situated about 30 miles to the east of Marseilles. This stone resists wear in lesser degree than porphyry (proportion 1 to 3.30), but not becoming smooth and slippery so easily, is used also wherever a steep incline in the street occurs.

Where an incline exceeds 7 per cent. the streets are macadamized. Side streets, where traffic is very light, and cross streets, are also macadamized.

The macadam is composed of a layer of about 25 centimetres thick ($8\frac{1}{2}$ inches) of calcareous stones, broken to 2 to 6 centimetres, from the quarries around Marseilles, and a thin layer of light quarry waste as surface binding material, the whole firmly compressed by steam rollers.

The cost of a street paved with porphyry amounts to 16 to 18 francs per square metre (say \$3 to \$3.50 per square yard), according to the size of the paving stones, including cost of all materials and labor. The cost of a street paved with La Ciotat sandstone amounts to 13 francs (say \$2.50) per square yard, including materials and labor. The cost of maintaining paved streets averages 65 centimes per square metre per annum (say 13 cents per square yard per annum), but reaches 2.50 francs (50 cents) in streets where traffic is the heaviest.

The cost of St. Raphaël porphyry stone delivered in the city of Marseilles is, crude (rough hewn), 11 francs (\$2.16), and cut to proper dimensions 13.20 francs (\$2.55) per square yard; that of La Ciotat sandstone, crude, 6.60 francs (\$1.28), and cut, 7.92 francs (\$1.55) per square yard.

The cost of macadamized roads is as follows: The calcareous stones, broken and ready for use, cost 6 francs (\$1.16) per cubic metre, and the cost of a road made of such stones, including layer of light stones, rolling, and all labor, amounts to 2.58 francs (52 cents) per square yard. But as the macadamized streets of Marseilles are generally bordered on each side with paving stones of La Ciotat sandstone, forming a shallow gutter about 2 feet 6 inches broad, in order that running water should not wash the sides away, the cost of such a macadamized street of 20 feet breadth, exclusive of sidewalks, amounts to 5.09 francs (\$1) per square yard. The cost of maintaining a macadamized street averages 19 centimes for the materials and 14 centimes for labor, say 33 centimes in all, per square metre per annum ($6\frac{1}{2}$ cents per square yard per annum), but reaches 1.65 francs (33 cents) for streets that are very frequented.

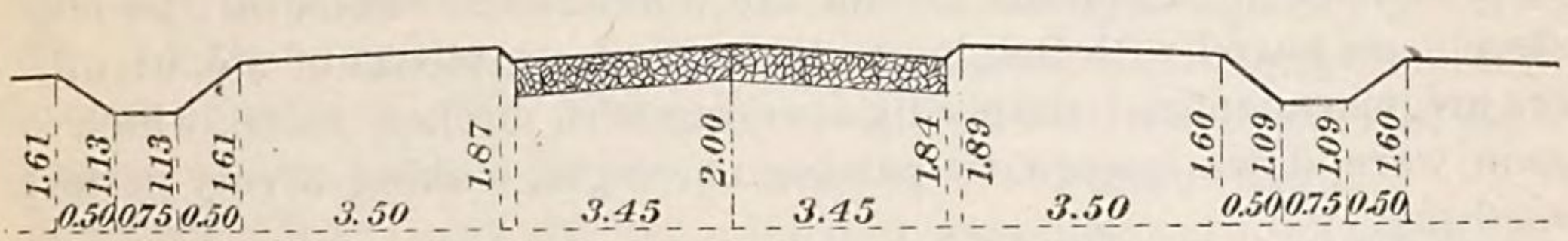
The city streets are maintained exclusively by the city funds (the city budget), and no special tax is levied for them, unlike village and country roads (chemins vicinaux), for which an additional tax is collected.

The foregoing estimates of cost do not include the value of the land occupied by the public streets, as same is too varied to be given accurately.

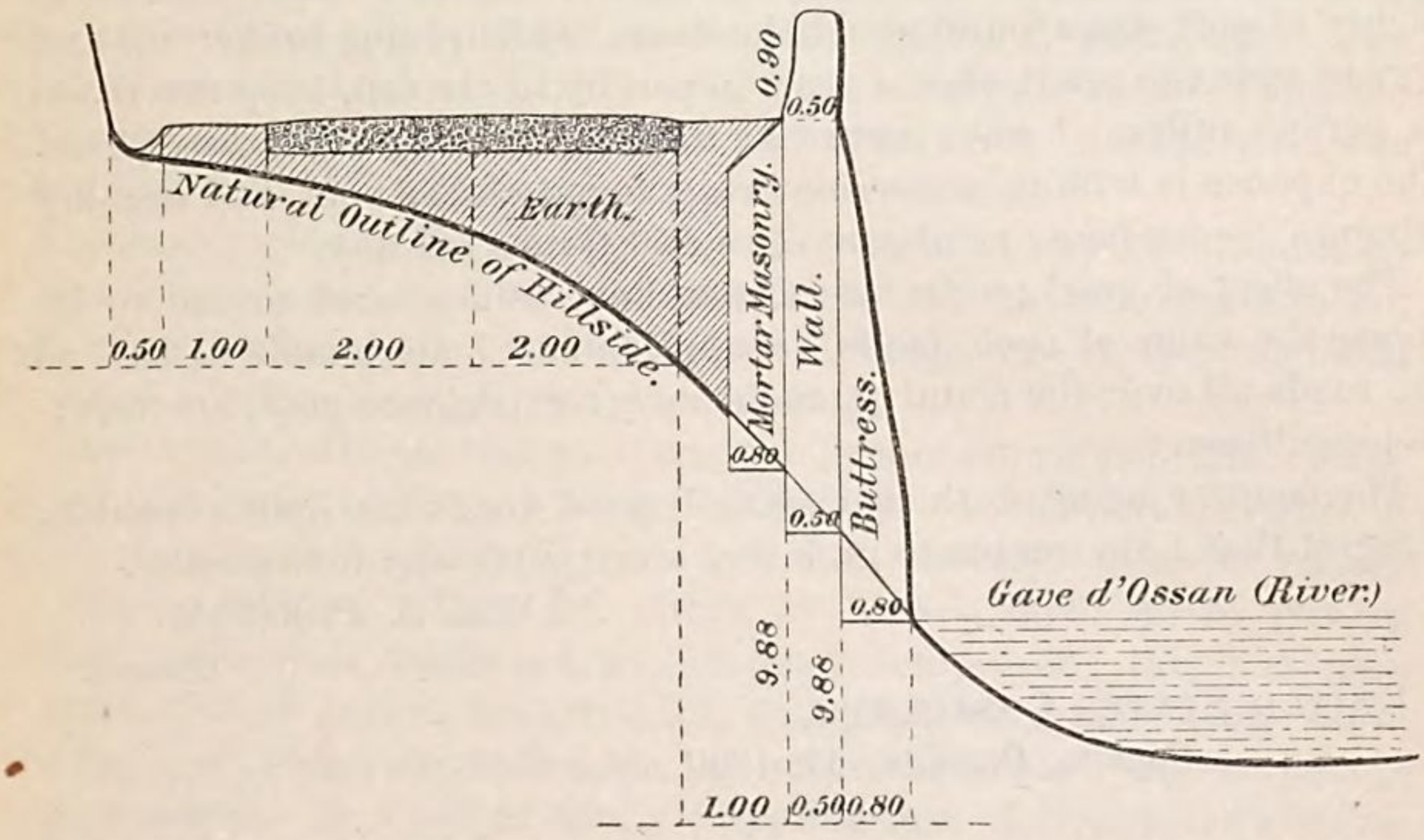
The following notes are sectional drawings of a national highway, a departmental highway, and a country road.

C. B. TRAIL,
Consul.

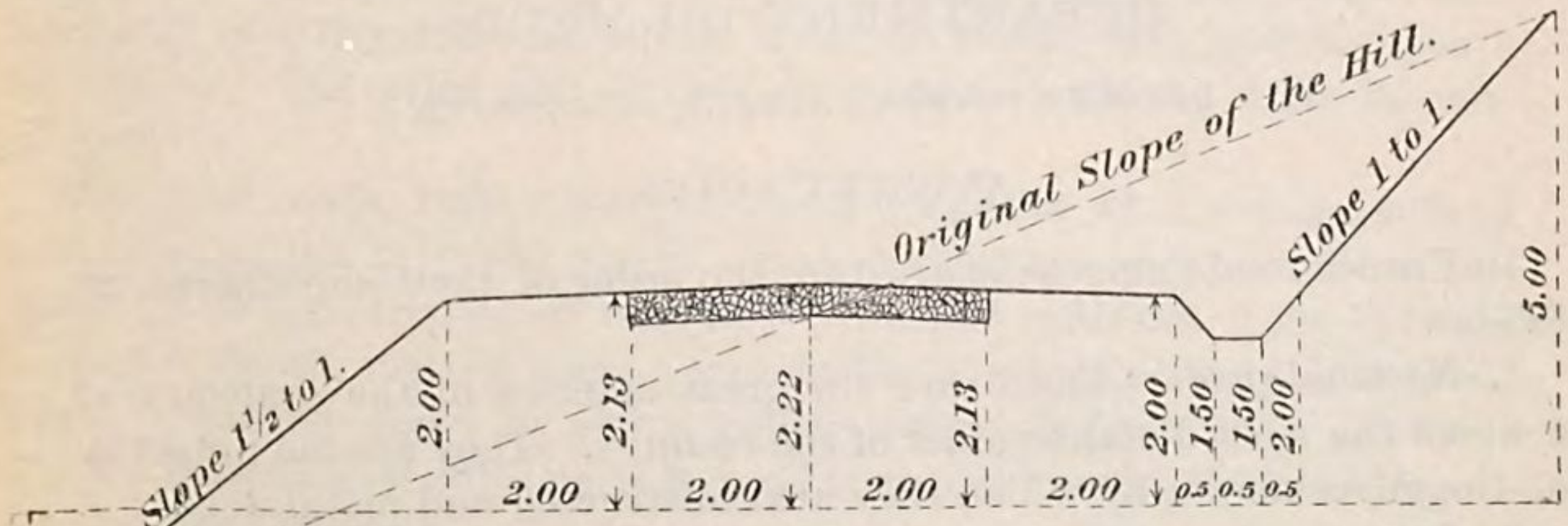
UNITED STATES CONSULATE,
Marseilles, March 4, 1891.



Section Route Nationale. No. 138. Department of Eure. (Measures and heights given in metres.)



Section, Route Départementale, No. 18, Basses-Pyrénées. (Measures given in metres.)



Section of Chemin Vicinal, Seine-et-Oise. (Measures given in metres.)

COGNAC.

REPORT OF CONSUL PRESTON.

In France there are three kinds of public roads: (1) The grand roads of the state, which are maintained at the cost of the state by a special tax; (2) the departmental roads, or roads of the departments leading from one principal town to another, are maintained at the expense of the departments, also provided for by a special tax; (3) the communal roads and streets of the communes, or cities and villages, are also provided for by a special tax on the inhabitants. Some of the city streets are paved with Belgian pavement, square blocks of stone; others are macadamized simply by covering with broken stone, which is soon worn down smooth by passing carriages, making a very perfect roadway.

In the country it is permitted to the inhabitants to make these roads themselves instead of paying a tax. In this district there is plenty of soft stone found along the roads, which, being broken up and spread over the roads once a year, generally in the fall, keep the roads in perfect order. I have never seen better country roads anywhere. The expense is trifling, the stone being found on the spot, and the day laborers' wages being small, say 2 to 2.50 francs per day.

The effect of good public roads upon land values is of course to increase the value of such lands, to what extent I am unable to say, as the roads all over the country, as far as my experience goes, are in perfect condition.

The country being so thickly settled, good roads are indispensable. I regret that I am unable to give any more particular information.

WM. S. PRESTON,
Consul.

UNITED STATES CONSULATE,
Cognac, December 17, 1890.

DEPARTMENT DU NORD.

REPORT BY CONSUL ATWELL, OF ROUBAIX.

COUNTRY ROADS.

In France roads may be classed in the order of their importance, as follows:

1. *National roads.*—These are the great arteries of the system, and connect the most distant points of the country. They are the property of the government, by which they are constructed and maintained.

2. *Department roads.*—These connect different points of the same department or of two adjoining departments. These roads belong to the department through which they run, and are constructed and maintained by funds appropriated by the department.

3. *Highways.*—Highways belong to the township or commune which they traverse. In theory these roads are built by the commune, but in point of fact they are made and repaired by the department from taxes levied on the commune, supplemented by a department subsidy. In the department du Nord this subsidy amounts to two-thirds of the cost of the maintenance of the road.

4. *Public roads*, the property of the commune through which they run, are made and repaired by the department in which the commune is situated from assessments on the commune and by a department subsidy. In the department du Nord the commune bears only one-half the cost of repairs. The com mon council establishes the rate and distribution of assessments for the purpose of building new roads.

5. *Crossroads.*—These are maintained by sums derived from the ordinary revenues of the commune, and when necessary by additional taxation authorized by law. In special cases the department makes a grant from funds appropriated for the maintenance of crossroads. The cost of building these roads is divided between the department and the commune, the department assuming four-fifths of the indebtedness, the remaining fifth being a charge against the commune.

6. *Country roads.*—These are kept in condition by the commune. When they are impaired by unusual traffic the town administration may claim an indemnity, which, in case of disagreement, is established by a commission named by the department.

Construction.—These roads are inalienable and imprescriptible. Public roads in general have a central roadway, the minimum width of which must be 3 metres or 3 yards 9 inches, bordered when necessary by lateral ditches. They are either of broken stone or of paving blocks. Wherever traffic is heavy blocks are employed; they rest upon a foundation of gravel, broken brick and glass, slag and sharp sand, the depth of which depends upon the nature of the soil upon which it is superposed. In a soil of sandy clay, like that of Roubaix, the foundation is from 10 to 12 inches in depth. The paving in use in this department is usually Belgian porphyry-granite from the Vosges and Brittany, and the different stones from the north, east, and northeast of France. The price per surface yard varies with the material employed.

Macadam roads, built wherever travel is light or wherever the cost of transporting the material would increase the cost of the road to too great an extent, consist of a layer of crushed material from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in depth, resting upon a foundation like that already described. This is packed down by steam rollers weighing from 10 to 15 tons. Under favorable conditions this road is rapidly made, is durable, and costs little for repairs.

CITY STREETS.

These are classified and private; the former belong to the city and are constructed and maintained by the city; the second are the prop-

erty of private individuals, who are compelled by law to keep them in good condition.

In the town of Roubaix macadam is employed for light travel and paving blocks for heavy traffic. The sidewalks are of sandstone and granite blocks or of cement or asphalt blocks.

The broken stone or macadam roads have a foundation of furnace refuse or broken brick from 10 to 12 inches in depth. Upon this is a layer of silicious gravel from St. Omer, or, better still, broken porphyry from the Belgian quarries, worth $2.56 the cubic metre. The average price of macadam roads may be estimated at $1 the surface metre. The work of repairing is met by a general assessment and is relatively high in Roubaix on account of the defective manner of construction owing to the employment of rollers of too little power.

Paved streets are upon a foundation like the above, about 10 inches in depth and worth 38 cents, American value, the cubic metre; this foundation is covered by a layer of sand 4 inches deep, at $1.14 the cubic metre; paving blocks are then pounded into position by a paving beetle weighing 10 kilograms. The material in use in Roubaix comes from the granite quarries, situated in Pas-de-Calais, Ardennes, and in the neighborhood of the Oise and Vosges. The price per surface metre may be estimated at about $2.09.

These paved streets are kept in condition by taking them up in part or whole. As a rule, the blocks keep their place well and where there is a slight depression workmen are employed to raise the block and put sand underneath; when the depression is general, the street is torn up and remade upon a new foundation. In the first instance, the workman receives a trifle less than 3 cents, American value, the square yard; in the second, he is paid 9 cents per square yard. The materials are estimated apart and paid by the cubic metre.

For the above information I am indebted to the supervisor of streets and engineer of roads and bridges.

W. P. ATWELL,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Roubaix, February 2, 1891.

NANTES DISTRICT.

REPORT BY ACTING CONSUL BENNETT.

COUNTRY ROADS OR HIGHWAYS.

The routes, country roads, or highways of this consular district are most excellent and well worthy of study and imitation. They are made for heavy or light traffic, are as smooth as asphalt, and nearly as solid and durable as granite. It has evidently required many years of toil

and experience to arrive at the state of semiperfection in which we find the roads at present, but notwithstanding the time required and labor expended the results are most satisfactory.

Each state or department has charge of its own highways, the construction and maintenance of which is confided to a chief surveyor of the highways, who is under the direct authority of the prefect of the department. There are two or three classes of roads, the making of each being essentially the same, varying only as to width and as to details of maintenance. For the practical purposes of this study we will class them as two only, the large national or departmental routes, and the vicinal or rural roads connecting village with village, or making connection with the large national thoroughfares. The departmental routes are 8 metres in width, the rural roads 6 only; the making of the two roads is the same, but the maintenance of the national roads is often the more carefully attended to.

The methods adopted in this consular district for the making of roads are briefly as follows: After the survey and tracing of the line, the ground is carefully leveled and graded as much as is possible to avoid too abrupt ascents and descents. If a wide road of 8 metres is being made, a trench 4 metres in width and 7 or 8 inches deep will be excavated in the middle, leaving for walks a space of 2 metres on each side; this trench is filled with broken stone—stone broken to about the size of 1½ inches square. This mass of broken stone is then solidly forced into position by the use of heavy iron cylinders, which are rolled backwards and fowards over these stones until they become settled into one solid mass, smooth and durable.

These iron cylinders when empty weigh from 2,800 to 3,000 kilograms (6,150 to 6,600 pounds), and are sufficiently large to admit of an equal weight of stone being packed in the interior, which makes, when ready for use, a weight of from 12,000 to 13,000 pounds.

A transversal diagram of a road as made here would be something like the following:

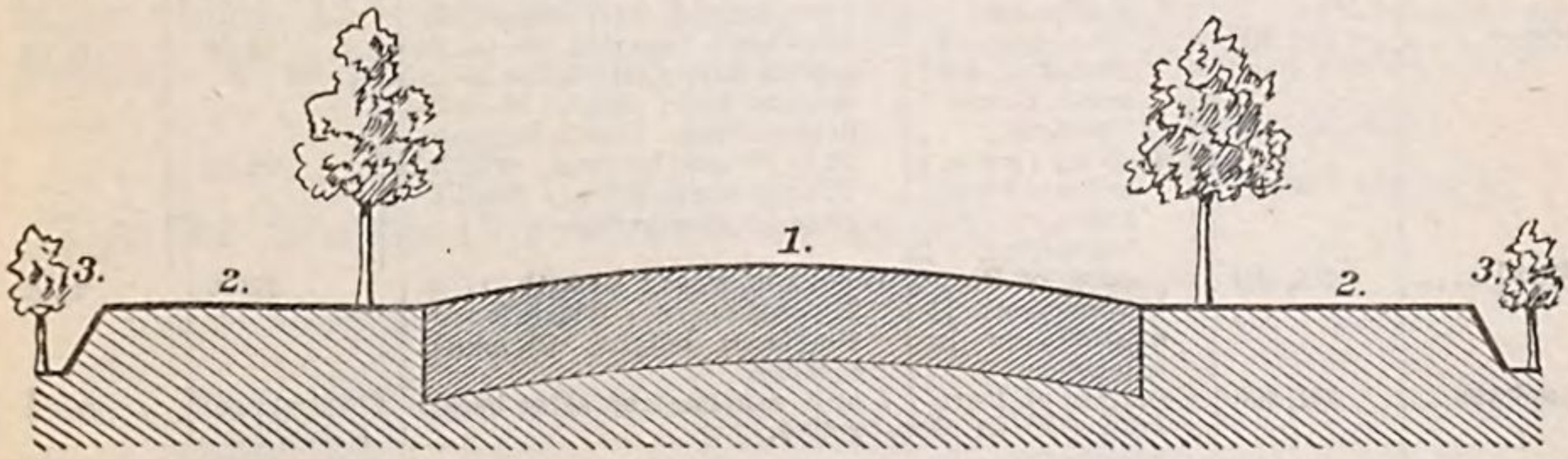


Fig. 1 representing the roadbed of broken stone, slightly rounded; figs. 2, the walks on each side usually shaded with trees; figs. 3, a ditch and hedge or stone wall, as the case may be.

The first cost of making a road of this class is from $1.25 to $1.75 per square metre, the price varying according to the amount of grading required and to the facilities of procuring the proper kind of broken stone, for it seems that some kinds of stone give better results than

others. A species of quartz gives the best results as to uniformity and durability. Within 1½ miles from Nantes is found an immense granite quarry, which furnishes excellent blocks for monuments, building purposes, etc., also small blocks for city street paving, where it resists in a manner perfectly satisfactory; but this same granite, broken small and pressed into a roadbed, is soon reduced to powder under heavy traffic and is often in need of repair, while quartz resists satisfactorily for a number of years.

The system employed in this district for maintaining the roads in good condition is very simple and inexpensive. The roadbed is allowed to wear away some 2 or 3 inches, when a new layer of broken stone is brought into requisition in the same manner as at first, they being pressed into uniform smoothness by the use of the heavy iron roller. This repairing is more successful when performed during the rainy months of the winter season.

The cost of repairs is about 5 cents per square metre.

H. D. BENNETT,
Acting Consul.

UNITED STATES CONSULATE,
Nantes, February, 1891.

PARIS.

REPORT BY CONSUL-GENERAL KING.

Kind of pavement.	Surface, Jan. 1, 1890.	Kind and thickness of foundation.	Kind and thickness of materials forming revetment.	Average price per square metre.	
				First establishment.	Annual expenses, including general repairs.
	Sq. metres.			*Francs.*	*Francs.*
Stone	6,336,900	(1) Sand 20 to 30 centimetres in thickness. (2) Concrete of lime, 15 centimetres in thickness. (3) Concrete of Portland cement, 15 centimetres. (4) Ballast, rolled, 15 centimetres after rolling.	Paving stones of hard sandstone, of "arkose" of granite, and of porphyry, as follows: Large: Length, 23 centimetres; width, 16 to 23 centimetres; height, 23 centimetres. Medium: Length, 16 to 20 centimetres; width, 14 to 18 centimetres; height, 16 to 20 centimetres. Small: Length, 16 to 20 centimetres; width, 12 to 14 centimetres; height, 12 to 18 centimetres.	20.00 24.00 24.50 24.00	0.74
Wood.....	484,900	Concrete of Portland cement, 15 centimetres in thickness.	Blocks of wood: Length, 17 to 27 centimetres; width, 8 centimetres; height, 15 centimetres.	20.50	2.50
Asphalt ...	301,400	Concrete of Portland cement, 15 centimetres in thickness.	5 or 6 centimetres after being rolled.	Thickness of 5 centimetres, 20.50 francs; thickness of 6 centimetres, 21.50 francs.	2.00
Gravel.....	1,510,200	This pavement, or roadway rests directly on the soil in which the gravel packing is placed.	Porphyry, millstone, pebble, 25 to 30 centimetres in thickness.	Porphyry, 8.30 francs. Mill-stone, 6.65 francs. Pebble, 4.65 francs.	3.70 2.47 1.30

Stone.—The cost of stone pavement on sand foundation varies from 16.60 to 24.80 francs. The extremes of these prices correspond to specimens of paving stones which are now only exceptionally employed. The same holds good for the three other kinds of pavement for which the average prices only differ from the figure of 20 francs by reason of the supplementary cost for the foundation. The pavements on concrete or on rolled gravel (the latter are rarely adopted) have been made only a few years ago, and form but a relatively small surface. The trials had with these revetments up to the present time are not yet conclusive enough to allow a possibility of pronouncing definitely on the advantages and inconveniences they present. However, the results obtained up to date seem to indicate that recourse should be had to solid foundations only in the three cases following: (1) When the soil is clayey or insufficiently resistant; (2) when there are lines of tramways; (3) when the circulation or traffic is very intense and at a rapid pace. It is now considered as indispensable to interpose between the foundation and the pavement a layer of sand of 5 to 10 centimetres in thickness.

Wood.—The extremes of the prices paid to the lessees who have constructed these pavements under contract, and who keep them in repair under the same conditions, are 2.08 and 2.95 francs for each of the 18 annuities, comprising, moreover, not only the ordinary keeping up, but also the repairs throughout the duration of the contract. The new wooden pavements are now constructed and kept up, with very rare exceptions, exclusively under the self-management ("*régie*") of the city of Paris, which realizes by this combination an economy of about 15 per cent. on the average price of 20.50 francs indicated under this heading. The paving blocks rest always directly on the foundation, which is covered over with a smooth plastering.

Asphalt.—The asphalt pavement is kept in repair by the contractors.

Gravel.—Porphyry and millstone do not always form the total thickness of the road. This is generally composed of a first layer of crude pebble 15 to 20 centimetres thick laid on the soil, and of a second layer about 15 centimetres thick, either of porphyry, millstone, or pebble. It is the second layer that gives its name to the revetment.

ADAM KING,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Paris, January 11, 1891.

RHEIMS.

REPORT BY CONSUL ANGIER.

CITY STREETS.

Generally in the cities and towns of this consular district the streets are substantially and beautifully paved with granite "Belgian blocks" from the famous quarries of "Vosges," a department of France in this

consular district bordering Alsace, the granite being of excellent quality and lasting a long time.

The manner of constructing these streets is as follows: First an excavation is made to the depth of about 16 inches from the proposed surface of the street when finished; a sand foundation or bed is then thrown in to a depth of 8 inches (the soil here is of chalky formation, well disposed to hold the sand well, without any primary layer of tar and gravel) and then the Belgian blocks are carefully laid on the sand. These Belgian blocks are 8 inches in depth, 6 inches in breadth, and 6½ inches in thickness. A heavy granite curbing, a little raised from the street, is the dividing line between the street and the "sidewalk." The "sidewalks," by the way, are paved much in the same manner as the streets. After the Belgian blocks have been laid in the streets, sand is thrown on to the depth of about ½ an inch, which is swept and reswept, back and forth, with heavy brush brooms, until every crevice and interstice between the blocks is filled. In a few months afterwards sand is again thrown on and the sweeping process renewed until the whole is very compact.

A street made in this manner will last from 30 to 40 years, very little repairs needed, and costs $3.17 per square metre (a square metre is 10.7642 square feet), the cost divided as follows:

31 Belgian blocks	$2.52
Sand	42
Labor	23
Total	3.17

The land owners are not required to pay any proportion of the cost for making, paving, and maintaining the streets, but are required to pay one-half of the expense for making and paving the sidewalks.

COUNTRY ROADS OR HIGHWAYS.

In the open country the main highways used to be paved, as are the streets now in the cities, but this was abandoned years ago, and the roads are now made simply of crushed stones of an average size of 4 inches, and then the heavy "steam roller-crusher" is run over it, back and forth, several times. Sometimes when the natural soil is not compact or solid enough, a good foundation is made for these crushed stones, but this does not occur often in this section. This foundation, when needed, may be quite a pavement of rough stones, or sometimes only a bed of sand or gravel is used for a foundation in places where it is sought to preserve the underground from the frost.

The main highways are Government roads, and were constructed and are maintained by the departments of France in which they are located and through which they run, and cost in this department (Marne) an average of about $9,300 per mile for their first establishment or construction.

The smaller roads are maintained by "la commune" (the people) through whose lands the roads run, and cost about $3,200 per mile for their primary establishment and construction.

The maintaining of the Government highways in good condition requires about 850 cubic feet of broken stones per mile per annum. The broken stones (or ballast) used for this purpose are obtained either from the flint stone quarries in the mountains near Rheims, or from quartz brought from the department of Ardennes.

The statements made in this report and the figures given may be relied on as quite acurate, nearly all of my data of information having been obtained from the Government engineer of bridges, roads, streets, and canals, having charge and control of all the bridges, roads, streets, and canals in a part of this consular district.

Though I have tried to get the information on which to base a report as to "the effect of improved public roads on land values," I can not make any report on that point. I am writing of roads located in and running through a country that, it is said, was overrun by the soldiers of Julius Cæsar, 50 years before Christ, and a later effort of the same sort, it is also said, was attempted in the fifth century by the Huns, from the shores of the Caspian Sea, under the leadership of Attila, and these roads have been maintained in their present good condition for so long a time it is difficult to approximate their effect upon land values.

ALTON ANGIER,
Consul.

UNITED STATES CONSULATE.
Rheims, December 22, 1890.

GERMANY.

AIX LA CHAPELLE.

REPORT BY CONSUL ZEIGLER.

CITY STREETS.

They are built of hard sandstone, where level or nearly so, but for heavy grades of somewhat softer quality. They are built and kept in repair by the city, and a general tax is levied for that purpose.

The stone used have a surface of 4 by $6\frac{2}{3}$ inches by 7 inches deep, and about 45 are laid to the square yard, in courses across the street.

The foundation is of sand, about 8 inches deep.

The stone is hauled 6 miles by team, is cut by hand to the proper size, and costs the city, delivered, $1.82 per square surface yard.

The laying of stone and sand furnished is usually done by contract, at a cost of 42 cents per yard, making total cost $2.25.

All new streets are built alike, whether for light or heavy traffic.

The sidewalks vary from 2 to 12 inches above street, with curb-stone 7 inches wide and of various depths, and foundation consists of cement 4 inches thick or deep, covered with sandstone $4\frac{2}{3}$ inches square by $3\frac{1}{2}$ inches deep.

This is a very ancient city, and many of the old streets and sidewalks are made entirely different from the foregoing.

It is impossible to obtain figures as to cost of repairs.

As a rule, but very little is required for many years after a street is newly built, no matter how heavy the traffic, as they are well made, and I am informed that in many cases where streets were built over 50 years ago but few repairs have been needed.

The tires used on wagons for heavy traffic are usually about 5 inches wide, which may, to some extent, account for the durability of the stone on the street bed.

The city pays its laborers who repair streets from 60 cents to $1 per day of 9 hours.

COUNTY ROADS OR HIGHWAYS.

There are eight main roads leading out from this city, but no one living here now can remember of either one of them being built.

They are hundreds of years old, built by the Government, and kept in repair by it.

Four of them are constructed, quite a distance, the same as the city streets or nearly so, and cost of same would be, say, $2.25 per square yard.

The others are macadamized about 7 inches deep, with small, hard sandstone, and present cost to construct or build would be 45 cents per square yard.

They are kept in repair by supervisors, appointed by the Government, for the various road districts, with but little expense.

It would be impossible to give any data or figures as to effect of improved roads upon real estate or the surroundings, all having been built so long ago.

S. B. ZEIGLER,
Consul.

UNITED STATES CONSULATE,
Aix la Chapelle, December 30, 1890.

BAVARIA.

REPORT BY CONSUL BLACK, OF NUREMBERG.

STREETS OF NUREMBERG.

The streets of the city of Nuremberg which are located within the old walls are all paved; those outside are only paved where the traffic on them is extraordinarily heavy.

The entire paved area is 583,875 square yards. Granite and sandstone (quartzite) are the materials which have been mostly used, for the last 15 years the former has been exclusively used. It is brought from the Bavarian Mountains.

The granite paving stones are of a shape resembling a parallelopiped, with sharp corners, having a length of from 6 to 8 inches, a width of from $5\frac{1}{2}$ to $6\frac{1}{4}$ inches, and a height of from $5\frac{1}{2}$ to 6 inches. The tops and sides have a smooth finish, the bottoms are more roughly cut; they must be flat, however, and never more than $1\frac{1}{4}$ inches smaller than the tops.

These stones are of the hardest blue granite, and cost $1.57 per 1,550 square inches free Nuremberg. All the material used in paving the streets is supplied by the city; in fact, it does all the work with the exception of the actual laying of the stones, which is given out to contractors.

The paving sand is a clayey kind of arenaceous quartz peculiar to the Pegnitz Valley, and the place from which it is obtained is the property of the city. The sand under the stones is loosely spread, at a thickness of from 6 to 8 inches.

The cost of paving with granite block of a street already opened, including all work and material, is $1.98 per 1,550 square inches. In the year 1889 there was expended for paving streets not previously paved the sum of $38,841.60, and during the same period, for repairing, the sum of $17,136 was expended.

There are macadamized streets in the new portion of the city to the extent of 503,516 square yards. These streets have been opened from time to time as the growth of the city demanded. The owners of the land through which they run are not only compelled to cede the bed, but are also required to bear the expense of making the street. The amount assessed to each property-holder is reckoned according to the size of his holdings; the amount charged per yard varies according to the size of the street. Contractors desiring to have a street opened in order to erect houses thereon must deposit with the authorities a sum equal to the whole cost of making the street, and until this condition is complied with the building permit is not granted.

The foundation of such streets consists of a layer of 6 to 8 inches of quartzite, a sandstone which is quarried at Wendelstein, near Nuremberg, and upon this a layer of Jura limestone 6 to 7 inches thick is placed. The whole is then thoroughly rolled with a large cylinder (pulled by horses) weighing 14,330 pounds. The cost of such a roller is $500.

The curbing used is hard granite. The gutters are $19\frac{1}{2}$ inches in width and are paved with granite stones.

The foundation stones cost 71 cents per 1,308 cubic yards, the small broken Jura limestones $1.43 per 1,308 cubic yards, and the curbstones $1.04 per 3.28 feet, all free Nuremberg.

These streets vary in their width from 18.04 feet to 64 feet, and cost from $7.10 to $10.90 per width of 3.28 feet running across the whole street.

Repairs of macadamized streets are never made with Jura limestone, basalt always being used for that purpose.

The cleaning of paved streets up to 26.25 feet from the footway falls upon the owners of the adjoining property; any over that is done by the city. A few streets where the traffic is very heavy are cleaned entirely at the expense of the property-owners.

Macadamized streets are cleaned at the expense of the city. For this purpose the city is divided into fifteen districts, each district having an overseer.

In autumn and spring he has two assistants. The removal of the dust and dirt from these streets is done by contractors. The city pays for the same according to the distance hauled and the size of the carts.

No special mechanical methods are used. In the year 1889 the cost of cleaning macadamized streets was $7,473.

Footways.—Footways vary from 3.28 feet to 16.4 feet in width, according to the width of the street. Curbstones are laid at once upon the opening of a street, but the paving of footways is only required when the city deems there is a need for it, and that work is done at the expense of the owner of the adjoining property.

In the old streets where new curbstones are required the expenses for the same fall half upon the city and half upon the owner of the property, while the cost of the pavement is entirely upon the property-owner.

The footways when paved are done with cement and clay plates; when not paved they are generally made of clinkers. No asphalt is used excepting upon some iron bridges.

As a rule, proprietors of adjoining land pay for the cleaning of all sidewalks.

HIGHWAYS.

The highways within the limits of this consulate are of a width of from 13.12 feet to 23 feet, according to the traffic passing over them, and have upon either side footways of from 3.28 feet to 5 feet in width.

The foundation of these roads consists of hard stones which are never affected by the weather. They are separately set one by one, points upwards, and are of a length of 7.87 inches. Upon this is placed a layer of small pieces of basalt or Jura limestone of a thickness of from 3.93 inches to 5.91 inches, the former stones being used for highways upon which there is a heavy traffic, the latter upon those where the traffic is light.

Basalt is broken by special machines into pieces varying in size from 1.18 inches to 1.77 inches in diameter. That used here is broken by the Basalt Company, Limited, located at Steinmuehle, near Bayreuth, in

Bavaria. The cost at the factory is $1.70 per 1.308 cubic yards; the cost including that of delivering at the place where they are to be used is from $2.45 to $3.18 per 1.308 cubic yards.

Jura limestone is delivered in larger pieces than basalt and is broken into small pieces by means of steel hammers at the place of delivery. The cost of same is from $1.43 to $2.14 per 1.308 cubic yards, according to the distance of the quarries from the place of destination.

Small piles of these stones for repairing purposes are constantly kept upon the sides of the highways. The work is usually done in the spring or autumn, when the ground is soft and moist. The roads are thoroughly scraped and swept before the stones are spread, which is usually of a thickness of from 1.18 inches to 2.36 inches. They are loosely but evenly thrown on and the traffic is depended upon to work them into the ground. If this be heavy, the road is made smooth in two or three days, but if light, two or three weeks are liable to be consumed in getting the material well worked in. The roadway is constantly dressed in this manner until it becomes perfectly level. Should it happen, however, during this time before the stones are well set that frost or dry weather should render the ground impervious, all the loose new material is removed and not again spread until the weather becomes wet and the ground soft.

The roadway is bordered on either side by what are called "frame stones." They are very hard and are not influenced by the atmosphere. The depth at which they are planted is 11.81 inches; their width is 3.93 inches. The footways of 39.37 inches in width have an incline of 1.97 inches.

I give you herewith a rough sketch of a highway which will elucidate more fully what I have written.

These methods apply only to the main highways, which are kept up at the expense of the state. In the hands of an experienced staff the best results are obtained. Practice, however, is necessary, in order to become acquainted with the best time and manner in which to spread the stones.

Cross-roads are, as a rule, not macadamized, and are kept up by and at the expense of the respective communities.

UNITED STATES CONSULATE,
Nuremberg, March 10, 1891.

WM. J. BLACK,
Consul.

BERLIN.

REPORT BY CONSUL-GENERAL EDWARDS.

The laying out and building of new streets within the city limits is a public interest only so far as the existing streets no longer suffice for the requirements of traffic and intercourse.

Nevertheless the street commission of the city of Berlin has been for many y ears extending the paving in a large circuit where it was not a public interest.

So long as the proprietors of land situated on proposed streets represented on the building chart of the city could build houses without considering if the streets were paved, if they were drained, if they were connected with an actual street, conditions were bound to arise which were very inconvenient for the inhabitants of such houses.

They regarded it as an injustice that they should not enjoy the same privileges as other citizens, and by their petitions exerted such a moral pressure on the communal authorities that their demands were granted.

A change could first be made after the passage of the law of July 2, 1875, concerning the building and alteration of streets and squares in towns and country places, and of the local statute of October 8–November 19, 1875, and after the issuance of the police regulation of September 12, 1879.

While under the cabinet order of December 31, 1838, proprietors of land bordering on newly paved streets were responsible only for the expenses incurred by the community in building such streets, they are now legally held for almost the entire sum expended by the town in finishing the street, and especially for the costs arising from the purchase of the street surface. As furthermore the building of dwelling houses is permitted only in such streets as are entirely paved and suitably drained, it is in the interest of the land owners, if they wish to use their property in this way, not to wait until by chance the streets on which their property lies are paved by the municipal street commission, but to have this work done themselves.

That the effect of this law upon the extension of municipal and private streets has been gradual is due to the fact that there was a considerable number of streets in which dwelling houses had been built prior to the passage of this law still to be put in order, and, on the other side, that it required a number of years before land owners realized that in consequence of the new law it was in their interest of their own accord and without municipal assistance to build the streets on which their property was situated.

How important, however, with time the effect has been can be seen from the following table, which exhibits construction and expense from 1882 to 1889, inclusive:

Year.	For account of—		Total.	Amount of expenses incurred by the city for paving streets.
	The city.	Private persons, street-car companies, etc.		
	Sq. metres.	*Sq. metres.*	*Sq. metres.*	*Marks.*
1882–'83	34, 233	11, 949	46, 182	469, 561
1883–'84	32, 158	6, 294	38, 452	474, 181
1884–'85	13, 939	12, 781	26, 720	236, 264
1885–'86	14, 709	17, 919	32, 628	282, 625
1886–'87	*42, 980	34, 849	†77, 829	925, 863
1887–'88	26, 260	26, 656	52, 916	449, 053
1888–'89	33, 350	59, 686	93, 036	‡575, 953
Total	197, 629	170, 134	367, 763	3, 413, 500

* While heretofore private streets were often constructed by the municipal street commission at the expense of the private parties concerned, in later years this custom has been abandoned. Only pavings which are to be made simultaneously by street car companies and by the city are laid by the latter at the expense of the former. From other parties constructing streets, for superintendence of the work by the city street commission, a charge of 20 pfennige per square metre of paving is collected.

†In this sum is included the paving of York street, which alone represented an area of 23,452 square metres. Of this, 16,929 was constructed by the city at its own cost, and 6,523 square metres at the cost of the "Great Berlin Street-Car Company."

‡The amount expended by the city in the year 1888–'89 for paving can not yet be stated exactly. From the fiscal balance, however, it may be estimated at about 576,000 marks.

If the subject of private paving is considered, it will be found from the above table and from the table already published for the years 1877 to 1881, that there has been considerable fluctuation. While the years 1877 to 1880 showed unusual activity on the part of private persons in this direction, in these 4 years 127,346 square metres of paving were laid at the expense of private parties, making an annual average of 31,836 square metres. In 1881 the amount fell off to 3,900 square metres, and from this time on it has risen to 60,000 square metres in 1888–'89.

This rising tendency, moreover, at present seems to continue, as is shown by the applications already received by the municipal street commission.

The number of streets proposed in the first three quarters of the year 1889 for paving in this manner was 21. Their total length amounts to 6* kilometres, and their total area to about 69,000 square metres.

Nevertheless the expenses incurred by the city for new pavings amounted in the 7 years covered by the above table to about 3,410,000 marks, or an average of 487,000 marks per annum.

These expenses naturally are really only outlays, as proprietors of land bordering on such streets upon building on their property must

* The completion of these streets by private speculators would add 12 kilometres to the street fronts of the city, while the streets finished by the city and by private persons between 1882–'83 and 1888–'89 have a length of 40 kilometres or about 6 German miles (over 25 English miles).

pay the expenses already incurred by the community in constructing the street.

The following table shows the amount paid into the city treasury under the statute of March 7, 1877, by land owners for the opening of new streets, as well as under cabinet order of December 31, 1838:

Year.	In accordance with—	
	Statute of March 7–9, 1877.	Cabinet order of December 31, 1838.
	Marks.	*Marks.*
1882–'83	95, 930	109, 493
1883–'84	106, 674	57, 383
1884–'85	80, 523	50, 395
1885–'86	100, 258	14, 669
1886–'87	211, 388	13, 827
1887–'88	227, 840	17, 966
1888–'89	416, 092	16, 742

If the figures of column two of the above table are compared with those of the last column in the preceding table, it will be seen that in no year has the amount paid into the city treasury under the statute of March 7, 1877, equaled the amount expended by the city in paving streets. In making this comparison it must be remembered that in accordance with the provisions of the statute, when streets are more than 26 metres broad, the area beyond this breadth must be paved solely at the expense of the community. Also with such parts of streets as border on tracts which by law or nature are not capable of being built upon, open squares, promenades, parks, railway stations, water courses, etc., no claim can be made by the city for recompensation beyond this limit.

The sums given in column two of the above table represent not only the amounts repaid to the city for expenses incurred in the purchase of the land on which the streets are constructed, but also construction and first paving costs. Yet the latter are not fixed for persons building on the street exactly in accordance with the amounts in the bills, but at a price per square metre which is fixed every year by communal order. This price differs for principal and side streets, and it can not exceed the cost of the lowest quality of paving permissible for such streets.

At first the price unit per square metre of paving was fixed at 11.50 marks in side streets and 13 marks in principal streets.*

These prices were originally adopted because it was thought that they would approximate but never exceed the actual cost price. Ten years' experience has, however, shown that these price units fall considerably behind the real cost. Accordingly, the prices have been raised to 13 marks in side streets and 14 marks in principal streets.

In similar manner payment of the costs of drainage is regulated where such in new streets is obtained through connection with the gen-

* These are such in which the paving rests upon a rolled substructure, such as is used for public highways, while in the side streets the substructure is merely a gravel bed.

eral municipal canalization. The land owners in new streets could not well be asked to pay the costs of an entire radial system which, perhaps, had come to be a necessity, without regard to the new streets. In like manner the amount actually expended in this way could not be charged to the persons having property bordering on such streets, because the land owners on the streets near the pumping stations would be burdened with the cost of the expensive masonry canals, while persons having property in the upper part of the radial system would have to pay only for the construction of the much cheaper earthenware tube drains, although these would be useless without the costly canals.

It had been learned from the canalization commission that in radial system III—which is relatively the cheapest of the systems—exclusive of the cost of the pump station and the forcing-pipe connections, the cost of the drains was 4,154,073.44 marks. As the street front in this radial system amounted to 78,443 metres, the cost per metre was 52.96 marks. Hence it was decided on February 29, 1884, whenever, upon building, the repayment of these costs becomes due, in such streets in which drains are laid simultaneously with or soon after the paving, the sum to be paid is 50 marks per metre of street front.

If the foregoing tables show that the activity of the municipal commission in laying new pavings has, since the second half of the decade beginning with 1870, materially deceased, yet since the same period in the matter of repaving there has been an enormous increase.

With the transfer of the streets to the municipality in 1876, on account of the increased traffic and the growing demand of the public, it became necessary to begin replacing with good suitable paving the old paving, which was almost all very bad, most of it having been laid during the first half of the century.

In the years 1877–'81 the average annual amount of bad pavement replaced by good was 55,200 square metres. In the period 1882–'89 this annual average has increased to 133,630 square metres.

The following table shows for the separate years the area repaved, and the amount paid out by the city for the purpose on its own account and for the account of street-car companies, the latter being responsible for the costs of paving between and near the rails in those streets in which, simultaneously with the repaving, the laying of the tracks takes place:

Repaved in the year.	For account of city.			For account of street-car companies.			Total.	Cost of repaving for account of city.		
	Asphalt.	Wood.*	Stone.	Asphalt.	Wood.*	Stone.		Wages.	Stone.	Total.
	Sq. met.	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Marks.*	*Marks.*	*Marks.*
1882–'83 ...	55, 445	7, 306	27, 238	7, 669	888	11, 121	109, 667	958, 531	639, 913	1, 598, 444
1883–'84 ...	63, 764	11, 837	43, 649	1, 570	4, 361	8, 527	133, 708	1, 815, 271	597, 750	2, 413, 021
1884–'85 ...	71, 971	3, 028	46, 725	1, 838	3, 197	5, 313	132, 072	1, 353, 766	818, 892	2, 172, 658
1885–'86 ...	36, 943	1, 319	41, 083	496	380	31, 057	111, 278	1, 261, 535	944, 924	2, 206, 459
1886–'87 ...	50, 041	3, 945	91, 689	4, 555	8, 647	19, 379	178. 256	1, 266, 478	1, 146, 900	2, 413, 378
1887–'88 ...	71, 400	1, 631	46, 479	17	55	3, 210	122, 792	1, 698, 801	740, 031	2, 438, 832
1888–'89 ...	77, 402	1, 757	52, 950	5, 324	.....	10, 232	147, 665	1, 785, 140	927, 631	2, 712, 771
Total ..	426, 966	30, 823	349, 813	21, 469	17, 528	88, 839	935, 438	10, 139, 522	5, 816, 041	15, 955, 563

*Under the date of April 17, 1891, Consul-General Edwards sent the following, translated from a Berlin journal: It is reported that the wood pavement, which was laid in many streets of Berlin, has worn so badly that the municipal street commission has decided to entirely stop using this material for paving purposes. Every sort of wood which has yet been tried has rotted in a comparatively short time, and its upper surface has become so much injured that repairs are hardly possible. Also, the horses fall upon it much more easily than upon asphalt pavement.

For this reason, "The Great Berlin Horse Car Stock Company's" petition that the space between the rails of its tracks on Spandauer and König streets be repaired this time with asphalt has been granted, and this work will be finished during the coming summer.

Large as is the sum thus used, nevertheless, in view of the immense old tracks to be repaved, the fraction repaved each year is small. Hence, the deciding* each year which streets are to be repaved in the following year is very difficult, and the solution of the difficulty is not rendered more easy by the fact that, year in, year out, countless petitions are received, in which officials, societies, real-estate owners, and residents declare that exactly that street in which they live or carry on business is one of the very worst in the city, and that they must consider it an unfair distinction in favor of other taxpayers if their application does not receive immediate attention.

From the foregoing table it will be seen that of the materials used in repaving, the principal was asphalt, although the excess of this material over stone was small. In the years 1882–'89 over 448,000 square metres of asphalt paving were laid, while over 438,000 square metres of stone paving were laid in the same period. The victory of asphalt is due to the silence which prevails in the streets which are paved with it, to its comparative cheapness as compared with stone paving, and most of all to its great popularity with the public.

Asphalt pavements.—On account of the great importance which this sort of paving has won in Berlin, the following remarks in regard to its technical preparation may be found of interest:

In laying asphalt pavings in Berlin the heated asphalt powder is poured over the previously prepared concrete sub-bedding, and by beating or rolling is reduced to a surface unbroken by seams. Since the year 1887 this work was done by four contractors only, who used asphalt stone from Bal de Travers in Switzerland, Pyrimont-Seyssel in France, and Ragusa in Sicily, and, as their bids were the same, the areas to be

*This decision was formerly made by the street commission, but for several years it has been made by the city council.

paved were given out in equal parts. To these contractors—of whom the one who used stone from Pyrimont-Seyssel has entirely given up street work—recently three new ones have been added, one of which—an English stock company—uses limestone from the quarries of St. Jean Marméjols, Department Gard, France, while the other two, local manufacturers, use asphalt, manufactured the one from Sicilian stone and the other from stone found near Ancona in Italy. As the new contractors have made decidedly lower offers for the sample pavings undertaken by them than the prices of the older contractors, it is to be hoped that in future the municipal street commission will succeed in having all its asphalt paving done at reduced rates, and in this way, without increasing expenses, be able to have considerably larger area of bad paving replaced each year.

As the places where natural asphalt stone, which, when in pulverized form, heated and stamped, reassumes a solid form, is found on our globe seem to be very few, human ingenuity has been exercised by artificial means to increase the supply; and here in Germany, as well as elsewhere, such attempts have been made. In reply to frequent applications for permission to test such artificial asphalts in Berlin, the municipal commission, recognizing its importance not only in a technical and economic way but also in its effects on home industry, has offered some of the public streets of Berlin for such experiments, but naturally at the risk and expense of the parties directly interested.

None of these attempts, though, have produced satisfactory results.

An American company, according to municipal reports, laid a paving in the Landsberger street, which before the end of a year had to be removed and replaced with natural asphalt paving. Also the paving in Köenig street, with artificial stamped asphalt, which was laid in the year 1883 by a German contractor, did not stand the wear nearly so well as natural asphalt pavements, and has already been many times entirely renewed. How satisfactory such paving materials may prove to be in streets where traffic is light has not yet been determined.

Greater durability seems to be possessed by an asphalt pavement recently laid by a German company in Wall street, near its junction with Spittelmarkt. A final judgment, however, can not as yet be given in regard to this any more than in regard to the so-called "caoutchouc-stamped asphalt pavement" tested on the Lüetzorr Ufer.

Wood pavements.—If asphalt, however—so far as natural asphalt is concerned—has shown a satisfactory degree of durability as compared with stone, the same can not be said of wood.

In the municipal reports for the years 1877 to 1881 information was given in regard to wooden block pavements laid in the years 1879 and 1881. In the following years until 1883 other trials were made with this material, especially in the squares before the Armory Museum and the Royal Opera House. For the former American cypress wood was used, and for the latter Swedish pine.

In the year 1884–'85 the area of such wooden pavements in the city of Berlin was about 42,480 square metres. Already in 1883 the wooden pavement laid in 1879 in Oberwall street had become so much damaged that half of it had to be relaid, the other half being renewed in the following year. The wooden pavement laid in the same year (1879) in the street east of the Royal Opera House was in such a rotten condition in 1884 that the street commission was compelled to remove the completely rotted and useless wooden blocks and to replace it with stamped asphalt. In the same way the pavement on Friedrich's bridge, and on Friedrich street between lot 103 and Behren street, after respectively 7 and 6 years' use, had to be completely renewed.

This experience shows why the municipal commission, while not exactly hostile to the extension of wooden pavements, still prefers to wait. It has, however, permitted the Great Berlin Street Car Company, which desired it in the interest of its horses, in streets which are otherwise paved with asphalt, to pave the area within and between the rails with wood. Here also results have been unsatisfactory, and, instead of wood of the pine family, impregnated beech wood has been tried. The first experiments of this kind were in the year 1886–'87 at the Müellen Damm, in Louisen and New William streets. Under these circumstances the area of wood pavements has not materially increased since 1884. On April 1, 1889, as above shown, it amounted to 62,336 square metres. For keeping nearly half of this area in repair the Great Berlin Horse Car Company is responsible.

The experiments in the use of beech wood are as yet incomplete, though it appears that in frosty and snowy weather such pavements are more slippery than any other.

Iron pavements.—The iron paving, which was laid in the year 1877 for a short distance on "Unter den Linden" by the King's and Laura smelting houses, was removed at the request of the experimenters very recently. In continuance of their experiment, however, they were permitted in 1887, at their own risk and cost, to lay a steel pavement on Lange street where it crosses the Wood Market and Marcus street. This steel pavement is composed of wooden impregnated blocks, in the form of paving stones, which, on their upper surface, are capped with steel. These blocks are laid upon a concrete under-bedding, and the seams are filled with a bituminous mass. This pavement, however, has not yet gotten beyond the experimental stage.

Area and cost of pavements.—Concerning the street areas, which at the close of the period covered by this report (April 1, 1889), were paved with asphalt, with wood, and with stone of different sorts, as well as concerning the areas to be kept in repair by the city, by street-car companies (in consequence of contracts to that effect), and by contractors (in consequence of the guaranty required of them—for stone pave-

ments 3 years, for asphalt pavements 4 years), the following table gives information. On the first of April, 1889, there were in existence:

Description.	Kept by city.	Kept by contractors, street car companies, and private persons.	Total.
	Sq. metres.	*Sq. metres.*	*Sq. metres.*
Good pavement:			
Asphalt	260,000	313,919	573,919
Wood	32,761	30,575	63,336
Stone:			
Class I, on broken stone sub-bedding	193,844	106,273	300,117
Classes II and III:			
Broken stone sub-bedding	258,103	139,920	398,023
Gravel sub-bedding	562,694	184,513	747,207
Total area good pavement	1,307,402	775,200	2,082,602
Bad pavement:			
Class IV	176,639	30,547	207,186
Class V	357,865	95,641	453,506
Classes VI and VII	1,209,491	71,292	1,280,783
Classes VIII and IX	660,116	17,343	677,459
Total area bad pavement	2,404,111	214,823	2,618,934
Total area of pavement	3,711,513	990,023	4,701,536

From this table it appears that of the pavings kept by the city 1,307,000 square metres, or about 35 per cent., are of good quality, while 2,404,000, or about 65 per cent., are of more or less bad stone. It is therefore apparent that the latter, which, with small exception, is at least 15 years old—a larger part being very much older—every year requires more and more repair and renovation. Even, therefore, if only the absolutely necessary repairs are made, the longer its replacement with good paving is deferred, so much the higher from year to year will the necessary outlay for repairs be. To what extent such repairs have been made in the separate years covered by this report, and what expense has thereby accrued to the city, is shown by the following table:

Year.	Street pavement.		Repairs.		Improvement.	Expenses.		
	In general.	To be kept by city.	No.	Area.		Wages, gravel, sand, etc.	Obtaining new stones.	Total.
	Sq. met.	*Sq. met.*		*Sq. met.*	*Per cent.*	*Marks.*	*Marks.*	*Marks.*
1882–'83	4,158,000	3,600,900	3,528	515,200	14.3	386,104	253,092	639,196
1883–'84	4,294,000	3,548,400	2,385	526,000	14.8	398,690	208,468	607,158
1884–'85	4,366,300	3,565,500	2,162	414,800	11.6	392,519	178,888	571,407
1885–'86	4,396,800	3,545,500	1,805	389,800	11.0	384,415	194,061	578,476
1886–'87	4,448,000	3,728,900	2,007	386,100	10.4	400,305	232,104	632,409
1887–'88	4,529,000	3,523,700	2,107	418,700	11.9	439,072	129,298	568,370
1888–'89	4,599,600	3,608,400	2,388	409,600	11.4	500,010	236,714	736,724

As the outlay represented in the next to the last column was only for new stones in order to obtain the actual money value of repairs in the period 1882–'89, to the sum 4,333,740 marks must be added the value

of old stones used again, 850,616 marks, which gives a total of 5,184,356 marks.*

The cost of repairs per square metre was therefore 1.416 marks exclusive of the value of old stones, and 1.694 marks inclusive of such value. The average cost of repairs on the entire street area was, exclusive of the value of old stones, 17.2 pfennigs, and inclusive of such value 20.7 pfennigs per square metre.

The labor and cost represented by the above table were expended in the interest of street intercourse owing to damages to the paving from traffic and atmospheric influences. But the streets of a modern city serve other public purposes than those of intercourse. Under the streets are the gas-pipe, canalization, pneumatic-tube, telegraph, telephone, electric-light and water-pipe systems. The laying and repairing of these subterranean systems render a frequent breaking of the street pavement necessary.†

Especially upon the better pavements, however, such breaking open has a bad effect, because they affect not only the street surface, but also the sub-bedding of the street.

Every effort has been made to bring the pipe and cable systems away from the streets and under the sidewalks. Yet at every street crossing the paving must be broken, and in most cases the municipal water pipes can not be laid under the sidewalks as they are not permitted to come within 5 metres‡ of the houses and a very large proportion of sidewalks are 4 metres, or less, wide.§

Years.	Work on water system in streets.		Amount of water pipes laid or relaid.
	Unimportant.	Important.	
	No.	*No.*	*Metres.*
1878–'81	3,862	15,446	22,702
1882–'89	2,931	20,519	27,269

*The city has a small income which somewhat reduces this amount. Persons who open public streets at their own cost are by statute required, during the first 4 years, for the purpose of keeping up repairs, to pay to the city an annual sum of 20 pfennigs per square metre. In the period from 1882–'89 the city's income from this source amounted to 48,447 marks.

†This applies chiefly to such systems as, for unanticipated causes, require extension. This does not apply to the municipal canalization, as the size of this is not influenced by the demands of the public, but by the amount of rainfall to be carried off. Furthermore the laying of this system nearly always precedes the laying of the better street pavement.

The renewal of the pavement broken open for such purposes is naturally not a municipal expense, but such repairs are made by the street commission at the expense of the department for which the work is done.

‡This regulation was adopted to protect from the water, in case of broken pipes, the cellars and foundations of neighboring houses.

§The following table shows how important were the operations of the water commission, on an average, for each year of the periods considered:

In addition to the paving expenses already alluded to, there are others in the city of Berlin which are as large as the entire outlays of many large towns for paving purposes. These expenses arise from widening old streets, the laying of special crossings on principal streets, laying of temporary pavements in the outer zones of the city, etc. Another expense is consequent upon the doing away with deep gutter stones, which is rendered possible by the extension of the general subterranean drainage system. At the beginning of the canalization work the length of these deep gutters in the districts of radial systems I to VII was 490,350 metres.

Of this before the beginning of the period covered by this report, *i. e.*, before April 1, 1882, 185,680 metres was changed to flat curbs.

In the years 1882–'83 to 1888–'89 there was removed—

Deep gutter stones.	Cost.			Value of old stones used.	Total value of the work.
	Wages, etc.	New stone.	Total.		
Metres. 274,877	*Marks.* 503,132	*Marks.* 298,114	*Marks.* 801,246	*Marks.* 139,333	*Marks.* 940,579

Altogether, therefore, 460,557 metres of old gutter stones have been removed.* Hence it appears that the old Berlin gutters have almost entirely disappeared.

Stone pavements: In spite of the growing use of asphalt in recent years, of the entire street area only 12.2 per cent. is asphalt paving, while 86.5 per cent. is stone. Even when only the better paved streets are taken into consideration the ratio remains 27.5 to 69.5.

The experience of former years taught that it was in every way more advantageous not to buy stones for special cases, but to have a large supply on hand. This, however, necessitates large storing places as well as numerous trained employés.

Of such storing places at the end of the period under report three were in use with a total area of 102,000 square metres. To these places, in accordance with the terms of delivery, the ordered stones are brought by the contractors, and, after unsatisfactory stones are refused, are unloaded by employés of the street commission and the amounts entered in the depot stock books. The entire depot business is under the charge of one of the six building inspectors of the street commission. The compensation of the depot bookkeeper, overseer, and workmen—the director is a life-long official, while the others are employed by the day—amounts to about 16,000 marks per annum. The building inspector has the assistance of three members of the street commission, department II, as curators.

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* The report of the municipal street-cleaning commission shows that in consequence of the removal of such gutters the amount of water used for cleansing the same has fallen from 512,397 cubic metres to 133,272 cubic metres.

In regard to the total amount of stone delivered during the period under report, the quantities of different sorts of stone, and the total cost, the following table gives information:

Years.	Broken stones, classes I to III.*	Broken and granite stones.		Sill stones for bordering track rails.	Total cost.
		Classes IV and V.	Class VI.		
	Sq. met.	*Sq. met.*	*Cub. met.*	*Metres.*	*Marks.*
1882–'83	57,033	16,221	9,351	39,316	1,358,287
1883–'84	89,029	27,533	6,994	3,951	1,651,360
1884–'85	89,833	16,145	5,429	3,238	1,565,529
1885–'86	116,226	17,458	5,039	1,805	1,964,296
1886–'87	136,045	8,243	581	27,378	2,105,930
1887–'88	92,572	22,746	2,000	17,713	2,107,695
1888–'89	114,038	11,622	4,442	17,406	1,669,707
Total in 7 years	694,776	119,968	†33,836	110,807	12,422,804
		255,312 sq. met.			

* The stones designated as classes I, II, and III are broken stones worked on all their sides into cubic or prismatic forms. Only these are used for distinct paving or repaving. The stones of classes IV and V are erratic blocks with worked square tops, while class VI represents stones broken in polygonal form. These last three sorts are used only for repairing old pavings made of similar stones.

† It is calculated that with every cubic metre of stone of class VI 4 square meters of paving can be laid.

From the above figures it appears that, leaving out of consideration the stone sills which are used for bordering street car track rails in asphalt streets, 73 per cent. of the stones obtained were for the best class of paving, classes I to III; while the rest, 27 per cent., were for repairing old pavings so far as the old stones could not be reused. It is the desire of the street commission to restrict as far as possible the purchase of these inferior stones (classes IV to VI) and to purchase the better sorts with the money thus saved.

The following table shows the origin of these stones. The stones from Norway and Sweden are exclusively granite, while the Belgian stones come from the porphyry quarries of Quenast, near Brussels. The Bavarian and Silesian stones are granite, while those from Saxony are porphyry, greenstone, and granite. The stones from Mark Brandenburg (classes V and VI) are exclusively produced from so called granite erratic blocks.

Year.	From—						Total.
	Sweden and Norway.	Belgium.	Bavaria.	Saxony and Silesia.	Mark Brandenburg.	Other countries.*	
	Sq. met.	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*	*Sq. met.*
1882–'83	44,994	9,453	982	13,132	42,097	.....	110,652
1883–'84	83,862	11,797	.....	8,705	39,573	365	144,308
1884–'85	67,927	26,219	.....	7,717	25,731	.....	127,594
1885–'86	75,367	41,360	.....	9,839	27,243	67	153,817
1886–'87	71,404	52,674	1,464	13,499	7,095	476	146,612
1887–'88	81,590	536	1,004	14,475	25,713	.....	123,318
1888–'89	80,485	32,177	618	1,136	24,912	.....	144,328
Total	505,624	174,216	4,068	73,503	192,364	908	950,629
Percentage of the total sum, not including Brandenburg stone...	66.67	22.90	0.53	9.69	.....	0.12	758,265

* Bohemia and the Rhine province.

The foregoing table shows that the vast majority of the stones come from abroad. Many futile attempts have been made to secure the stones in Germany, but so far the foreign competition has been irresistible. These attempts, however, have assisted the city treasury, as they have caused a fall of prices, as is shown in the following table:

Sort of stone.			Price per 1,000 with cubes, per square metre with prisms—	
Class.	Form.	Height.	Before the year 1885.	Up to April 1, 1889.
		Centimetres.	*Marks.*	*Marks.*
I	Cubes	19 to 20	795	700
	Prisms	19 to 20	18.75	17
	do	15 to 16	17.75 to 16.0	13.74
II	Cubes	19 to 20	493	480
	do	15 to 16	370	.....
	Prisms	19 to 20	13.10	11.74
	do	15 to 16	14.60 to 12.75	10.64
III	Cubes	19 to 20	478 to 450	454
	Prisms	19 to 20	12.85	10.74
	do	15 to 16	13.80 to 13.30	10.00

The total amount of good stones taken from old pavements during the period under report was 270,676 cubic metres. Of this amount 75,091 cubic metres were used again. The remainder was broken up and used as sub-bedding for stone pavements of classes I to III, and for other purposes. A part was sold to neighboring rural communities. As the demand therefor has been lively, the prices per cubic metre have risen from 4 marks to 7 marks and upwards.* The amount of stones thus sold was 49,761 cubic metres, and the receipts from this source were 253,793 marks.

Highroads.—In addition to the streets to which up to this point this report has been confined, there are also within a small part of the city limits highroads; and in addition to these, the city is also responsible for certain country roads built by it beyond the city limits. The reports for the years 1877–'81 show the length of such highroads to have been 70,600 metres. At the close of the period now under report, it had been reduced to 68,150 metres. This reduction is mainly due to the extension of paved streets. As rapid as possible reduction of this amount is desirable, as in warm weather such highroads are exceedingly dusty, and in wet weather they become dirty and slippery; and, furthermore, they are exceedingly expensive to keep in order.†

*In the year 1889 as much as 9.5 marks per cubic metre was offered and paid.

† While, as has already been shown, this cost for paved streets is 17.2 or 22.7 pfennige per square metre per annum, 10 years' observation has shown that the minimum average annual cost for keeping in order such chaussées was 22 pfennige. This cost (22 pfennige) was for the comparatively little used chaussée connecting the Charlottenburg road with the royal porcelain factory.

Name.	Cost per square metre per year, from 1877 to 1888.		
	Highest.	Lowest.	Average for 10 years.
	Marks.	*Marks.*	*Marks.*
Chaussées in the Thiergarten Park:			
Charlottenburg chaussées	1.72	.22	1.23
Lenné street	4.57	.67	1.72
Thiergarten street	2.25	.50	1.09
Spree way	3.04	.36	1.82
Sieges allée	1.77	.29	.77
Bellevue allée	2.68	.05	.56
Grosser way	2.59	.04	.56
Chaussées connecting the city with suburbs:			
Preulauer allée	1.76	.36	.86
Landsberger allee	3.40	.23	.97
Frankfurter allée	1.65	.24	.71
Reinickendoyer chaussée	1.27	.27	.67
Schönhauser allée	1.22	.32	.88

A further reduction of the extent of such chaussées, for whose preservation the city is responsible, will shortly result from an agreement made with the municipality of Charlottenburg. By this agreement Charlottenburg assumes proprietorship and charge of the chaussées on Salzufer and Charlottenburger Ufer, on condition of the city of Berlin paying to it the sum of 9,400 marks per annum. By this agreement is removed a disagreeable condition of affairs under which one city owned and was responsible for a street within the limits of another city.

Sidewalks.—So far this report has been confined to the streets of Berlin. In conclusion it may be of interest to say a few words in regard to sidewalks.

Long before the repaving of the streets began, the movement to replace the old sidewalks was inaugurated. This work was begun soon after the year 1830 by laying granite slabs in the middle of the sidewalks. The next improvement was the covering of those parts of the pavement on both sides of the granite slabs with mosaic-stone plates. Later on, house-owners were permitted to pave their entire sidewalks with asphalt.

A regulation on this subject was issued in 1873 which also gave assistance to land-owners from the city treasury. If one observes, everywhere where sidewalks border on impervious street surfaces, between the granite slabs or asphalt pavement and the curbstone, sometimes a half, sometimes a whole metre of mosaic strips, the reason therefor lies in this regulation. They have a double purpose: First, because if both street surface and sidewalk are impervious the danger arises that gas or water escaping from pipes under the streets, unable to escape upwards, must force its way sidewards into the cellars or under the foundations of neighboring houses. Second, because where it is intended to plant trees on the sidewalks their growth would be impossible with an unbroken street surface.

In accordance with the provisions of the order of the royal police presidency of January 17, 1883, and of the magistracy of February 6, 1874, during the period under report private land-owners laid 186,800

square metres of good sidewalk, and the assistance rendered in this direction by the city treasury amounted to 471,415 marks.

In addition to this, sidewalks were laid by the city in public squares, parks, and along water courses, to an extent of 126,357 square metres, at a cost of 513,722 marks.

W. H. EDWARDS,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Berlin, March 4, 1891.

FRANKFORT-ON-THE-MAIN.

REPORT BY CONSUL-GENERAL MASON.

The subject embraced by the inquiry prescribed in the Department circular of November 8 divides itself naturally, here as elsewhere, into two distinct topics, viz, paved streets in cities and towns, in which various systems of stone, wood, and asphalt pavements have been used with greater or less success; and (2) country highways, which in Germany are uniformly macadamized roads of varying width according to location and the quantity of travel and traffic to be accommodated.

MUNICIPAL STREET CONSTRUCTION.

In respect to sewerage, gas and water service and street pavements, Frankfort presents a complete and interesting example of a well-built and carefully kept modern municipality grafted on the somewhat rude and irregular stock of a mediæval walled city, laid out and constructed upon the ancient model, under which the principal consideration was the accommodation of the largest population within the limited space inclosed by its defensive walls. Down to the beginning of the present century Frankfort was a labyrinth of narrow, tortuous streets, opening at their intersections into small open spaces of irregular form and flanked by buildings five or six stories in height, which for greater economy of space often overhung by several feet the narrow pavement below. These streets were paved with small, round cobblestones, laid upon the natural but well-trodden gravel, and with such profile as to form open gutters at the sides of the wider streets or along the middle of the narrower ones. From 1801 to 1806 the outer walls were removed, the moat filled up, and the space thus acquired was converted into parks, which with the adjacent boulevards encircle three sides of the old town (the fourth being flanked by the river Main) and which now form one of the most attractive features of the city. From that period down to 1867 the pavements were exposed to all the exigencies of sewer-building, gas and water pipe laying, and made therefore little or no progress in quality or change in character.

In 1867 the principal commercial thoroughfares had been provided with gas, water, and sewerage and the construction of solid, well-laid pavements of dressed stone blocks began, subject to the further disturbance which came with the introduction of the first street railway in 1869. Frankfort stands on a level sandy river plain which has a substratum of loose gravel that absorbs water with great facility, and although favorable from a sanitary standpoint, forms an uncertain and treacherous foundation for pavements especially when the original earth has been previously disturbed by the laying of sewers or water-mains. It cost the Frankforters years of experience to learn the all-important lesson that in order to meet the constantly increasing requirements of modern city traffic the essential requisite of a successful pavement is a solid, deep laid, water-tight foundation, and that without this any pavement, however cheap in original cost and fair on the surface, is certain to prove extravagant and disappointing. So well is this principle now established that it is the custom to first grade and lay new streets with a temporary pavement of stone blocks set on the plain gravel and then after some years of use have thoroughly settled and solidified the ground to take up the temporary pavement, excavate to the required depth and lay in a permanent cement and rubble foundation, upon which the original stone blocks, from which soft or imperfect ones are carefully excluded, are then relaid. Frankfort has made careful experiments with macadamized streets and with permanent pavements of three materials, viz: cut stone, asphalt, and wood, and the costs and results in each case will now be separately considered.

Stone pavements.—Stone pavements are usually made of four-sided, wedge-shaped blocks of gray granite, which are obtained at various points, notably from Alsace, from quarries along the Rhine between Mayence and Coblenz, from Passau on the Danube, and from the mountains of the Odenwald. Black porphyry from the Bavarian Pfalz and basalt from the Vogelsberg near Hanan are used in slabs or large, broad blocks for paving narrow streets, but on account of their irregular hardness these slabs soon become rough and unsatisfactory, so that granite is now the standard material for roadways and straight curbstones. The method of construction for the best class of granite pavements in old and important streets is as follows:

The old or temporary pavement is first removed and the earth excavated to a depth of 16 inches. The bottom is then covered with a 2-inch layer of broken stone, over which a steam roller is passed to firmly embed this rubble foundation in the earth. If the bottom is of particularly loose and unstable material, or if veins of water render it soft, small, flat stones are selected, set on edge, and hammered firmly into place. Upon this substratum is then laid a bed from 6 to 8 inches deep of concrete made of best Portland cement mixed with sharp, coarse sand. When this has firmly "set" it is covered with an inch of clean, fine sand, which forms an elastic cushion between the solid con-

crete foundation and the pavement. Upon this are then set the granite blocks, 7 inches square at the top, 8 inches in depth, and tapering slightly from top to bottom to form the arch of the street surface. The seams between the blocks are calked with coarse gravel and melted coal tar, which not only helps to render the pavement impervious and thus protect it against the action of frost, but holds the blocks in place and prevents lateral motion. Such a pavement costs from 15 to 16 marks ($3.57 to $3.80) per square metre, a high figure, but the expense of keeping it in repair is next to nothing, and as it lasts indefinitely, it proves, like all good, genuine work, cheapest in the end.

Next in order come the ordinary stone pavements made of granite blocks similar to the preceding, but laid on the natural gravel or sand, which has been previously graded and rolled as hard as possible with a steam roller. For suburban streets or where traffic is light these common pavements serve reasonably well for a series of years, but they invariably become rough, expensive to clean and maintain, and in the end unsatisfactory. The comparative cost of the two foregoing classes of cut stone pavements—that is, the best and the ordinary grade—with their respective expense of maintenance during the first 5 years, are shown by the following table, in which the calculation is made per running metre for half the width of the street between curbstones:

Cost of front metre for half of street width.

Ordinary block stone pavement laid in sand.					Granite block, cement and rubble foundation.			
Width of street.	Construction.	Maintenance 5 years.	Total.	Equivalent per square metre.	Construction.	Maintenance 5 years.	Total.	Equivalent per square metre.
35 feet	$10.58	$1.19	$11.77	$2.11	$18.91	$1.19	$20.10	$3.78
45 feet	12.86	1.52	14.38	2.03	22.61	1.50	24.11	3.47
50 feet	14.28	1.69	15.97	2.00	24.99	1.66	26.65	3.51
70 feet	19.14	2.38	21.52	1.91	34.03	2.38	36.41	3.40

These statistics are somewhat complicated, and from an American standpoint may seem awkward, but they show the German method of keeping accounts for street construction and maintenance. It will be noted that the cost of keeping the two kinds of pavement in repair does not differ much during the first five years, but after that period the superior economy of the better grade becomes more and more manifest.

Of the macadamized streets in Frankfort there is not much to be said. This system was used extensively some years ago, particularly on the broad highways leading into the city, as well as on the circular boulevard which was constructed when the *enciente* was removed in 1806. There is found in this region a dark-colored slaty kind of limestone, which breaks easily and packs firmly on roads of this character. Macadamizing costs when well done about $2 per square meter, but it is the most expensive of all pavements to keep clean and in repair, requiring constant patching and filling to maintain a good surface. It is also

more or less pasty in wet weather, and loses rapidly from the process of street cleaning; it is dusty in dry weather unless constantly watered, and is, on the whole, better suited to country or suburban roads than city streets.

Asphalt pavements.—Of asphalt pavements it can be said that except for sidewalks they have been used only experimentally in Frankfort. The first pavement of this kind was laid down in 1880. Although such as have been laid have stood the test of use reasonably well, they have been subject to the usual objection of being dangerously slippery in muddy weather. Here, as elsewhere, it has been found especially requisite that asphalt pavements should be kept clean, and this is possible without great expense only where the same kind of pavement is laid continuously over large street areas and the margins where asphalt pavements are entered upon from macadamized or gravel roads kept free from mud by constant cleaning. Otherwise country wagons soon cover them with dirt which in wet weather makes the asphalt a slippery and treacherous footing. Experiments were made some years ago with a native asphalt from Sisal in Hanover, but it was of inferior quality, and has been replaced by the French material from Val-de-Travers and by asphalt from Sicily. Good asphalt pavement requires a firm rubble and cement foundation, and when well and thoroughly done after the process which has been so long and successfully used at Paris, costs in Frankfort from $3.30 to $3.50 per square metre, or nearly as much as the best kind of stone pavement, to which it is inferior in point of durability and expense of maintenance.

Wood pavements.—The experiments with wood pavements began at Frankfort in 1885, when a part of the "Zeil"—the principal business thoroughfare of the city—was paved with that material. Subsequently, a part of a much traveled street called the "Steinweg" was set apart for further experiment. Contracts were given to five different firms, who laid down their special varieties of wood pavement, in which were used German beech and pine, Swedish pine, American cypress and yellow pine, part of which were impregnated by different methods and part not impregnated at all. All these several wood pavements were laid in the most careful and thorough manner upon impermeable cement and rubble foundations, similar to those employed with the best class of granite pavements, and they are all in good condition to-day after more than 5 years of severe and constant use. As to which of the five varieties has proved superior, I can give only the opinion of Mr. W. H. Lindley, chief engineer of this city, who declares in favor of the Kerr system, an English method which has been employed on a large scale during recent years at London and Paris. The Kerr pavements laid down in Frankfort are made of blocks of Swedish pine 4 inches in depth, not impregnated, but set in a salve of melted coal-tar upon the orthodox cement foundation 8 inches thick, and which rests on 2 inches of broken stone. It is well known that the municipality of Paris has

adopted the Kerr wood pavement for some of its most important streets and avenues, under an arrangement by which the patentee lays down the pavements at his own expense and keeps them in good repair for a yearly rental of 2.50 francs (47½ cents) per square metre, a rate that would be considered extravagant in most European municipalities.

There appears, so far as can be ascertained, nothing mysterious or extraordinary in any of the wooden pavements which have been tried with such uniform success in Frankfort. The important fact is that they are all well and honestly constructed. Whether impregnation of the blocks is of any important advantage in this climate is an open question, but the three essential requisites are carefully observed, viz: 1, a solid, impervious, concrete foundation; 2, blocks of sound, well seasoned wood, carefully selected, and free from spongy, sap-rotted, or otherwise imperfect pieces; 3, each block firmly set in hot pitch, and the interstices poured full of the same material. There is no laying of wood pavements here upon pine boards resting on sand or gravel, with the frost lifting them out of place each winter and the water oozing up through them from every surface vein or leaking water main. Such experiments have been left exclusively to the more courageous municipalities of newer and less conservative countries.

Sidewalks.—Sidewalks were made in early times of cobblestones set in sand, then small squared granite blocks were used; next asphalt was extensively employed, but since 1876 the principal sidewalks in Frankfort have been built of concrete in the following manner: When the grading is finished and rolled to uniform hardness and solidity there is laid down a bed 5 inches thick of concrete, composed of one part of Portland cement and seven parts of coarse gravel. Upon this is then spread a surface coat 1 inch thick of concrete, containing equal parts of cement and fine clean sand. While the surface is still smooth and soft it is cross-hatched with shallow lines into rectangular or diamond-shaped squares, which give a finished appearance and offer a more secure footing in wet or wintry weather. Curbstones are of granite, with syenite blocks for curves and street corners.

COST OF THE VARIOUS PROCESSES.

From the last report of the city engineer of Frankford there is herewith translated the average cost per square metre of each process involved in constructing the various kinds of pavements and sidewalks, viz:

1. Smoothing and preparing surface, grading not included	$0.05 to $0.16
Sidewalks:	
2. Steinheim granite blocks in rows	1.19
3. Pfalz granite blocks in rows	1.55
4. Steinheim granite slabs	1.66
5. Concrete, per process above described	.95
6. Of molten asphalt spread over broken stone	1.15
7. Asphalt slabs from Val de Travers	1.90
8. Macadamized	.71

Street roadway:		
9. Of cobble stone, top dressed, on sand bed		$1.75
10. Square blocks Pfalz porphyry on sand bed		2.24
11. Square blocks hard basalt on sand bed		2.85
12. Square blocks Alsatian granite on concrete foundation	$3.90 to	4.40
13. Square blocks Vilshofen granite on concrete foundation		4.65
14. Molten asphalt on concrete foundation		3.70
15. Natural French asphalt on concrete foundation		4.65
16. Wood pavement, beech or pine	4.15	4.85
17. Curbstones of syenite, including setting on cement foundation, per linear metre:		
Straight		1.90
Curved		2.00

In the above items, from No. 12 to 16, inclusive, there is included 85 cents per square metre as the cost of the concrete and the rubble foundation, which, as already explained, is an essential part of all high-class roadway pavements in this city.

The expense of pavement construction is provided as follows: For repaving old streets within the city the whole cost is paid by the municipal treasury from the public fund. New streets in the suburbs are first paved at public expense, but when the adjacent property is afterwards built upon the city assesses upon the owners of such buildings the full cost of the paving in front of their land up to half the width of a street not more than 26 metres wide, the excess above that width remains to be borne by the public treasury. Finally, and this is a point which American municipalities should not lose sight of, permission is never given to private parties to cut the pavement through a street for any purpose. When such work is required the party desiring it applies to the proper bureau, the work is done carefully and thoroughly by the city authorities, and the party who has made the petition pays for it.

COUNTRY ROADS.

The excellent roads of Germany are mainly a heritage from the century which immediately preceded the introduction of railroads. In those days the mails and the few travelers who journeyed by public conveyance were carried by post chaises; freight was transported by great lumbering wagons, each drawn by six horses, and what was regarded as not less important in that period of prolonged and incessant warfare, broad, smooth roads were necessary for the rapid movement of the king's armies with their supply trains and artillery. Accordingly the construction and maintenance of public highways was then an important function of the national government, administered by a vast bureau or department similar to the department of Ponts et Chaussées now maintained in France. It required many years after the introduction of railroads to persuade the conservative officials of the Prussian Government that the period of freight wagons and post chaises was forever past, and that thenceforth their splendid system of

macadamized and graded highways must play a secondary rôle. The lesson was finally learned, however, and on the organization of the empire in 1870, or soon thereafter, the state assumed control of the principal railways and turned the public roads back to the care of the provinces. The consequence is that Baden, Wurtemburg, Bavaria, Westphalia, and the other provinces of Germany have each their separate system of administration for the construction and maintenence of public roads. This administrative machinery is based upon a political system so different from our own as to nearly or quite deprive it of all practical interest in this connection; but in respect to methods of construction the results of German experience may furnish some timely suggestions.

As a result of the circumstances already noticed very few new roads are now constructed in this part of Germany. The great national roads which were built before the railway period are adequate for all military purposes. The principal work of later years has been to improve suburban highways and secure easy communication at all seasons between important railway stations and the surrounding districts. For this purpose narrower and cheaper roads than those formerly built are frequently adequate, so that it may be said in general that the standard of road building has deteriorated during the last 20 years in all parts of Germany, except Baden, where the highest grade of excellence is still maintained. In respect to construction, the German process is identical with that of France and Switzerland. Every important road is a graded, macadamized turnpike, with culverts of massive stone, ditches on either side (which are paved wherever there is danger of washing) and generally lined with trees (either poplar, sycamore, or linden). All slopes and counterscarps are secured by grass, planted from seed when the soil is sufficiently fertile to receive it, otherwise by turfing. Where the slope is necessarily steep and unstable, it is faced like the retaining walls of embankments, with solid masonry.

The profile and alignment of each road is a skillful compromise between directness of route and an easy gradient. Wherever practicable, the road is a straight line between the points connected; when the exigencies of surface forbid this, the best skill of the engineer is employed to circumvent the obstacle by the most direct route compatible with a practicable grade. Bridges were formerly exclusively of masonry, but of late years iron and steel structures of various patterns similar to those used in the United States for railway and road bridges have been introduced. Wherever a German road is flanked by a slope or precipice which presents the slightest danger, the exposed side is guarded by a line of heavy stone posts, connected wherever necessary by railings of iron or wood, and in many places these pillars are of white basalt, which renders them more easily distinguishable at night. There is, apparently, no rigidly prescribed limit to the gradient of German roads. They are classed according to width, which varies from 7 to 8½ metres—that is

from 22.9 to 26.47 feet. The line and gradients having been established by survey, bridges and culverts constructed, and the whole surface of the roadway graded to a flat uniform surface of the required width, and all filled portions rolled and thoroughly settled, the wagon track, which is from 4 to 5 metres wide, is first spread with a 2-inch layer of broken stone which is crushed by heavy rollers into a firm and even foundation. If the ground should prove treacherous by reason of springs or quicksand, larger stones are chosen, set upon edge and rammed into place until a secure foundation is obtained. Upon this layers of broken stone are added, rammed and rolled to a depth of 21 centimetres (8½ inches). The wear of daily travel and tra ffic does the rest.

The cost of such a road depends naturally upon several conditions more or less variable, such as the nature of the ground and consequent expense of grading, the distances to which stone, earth, etc., must be transported, and other circumstances. The only method of reaching an approximate estimate is therefore to analyze the construction account of certain roads which have been built in Germany during the past 30 years.

For this purpose we select as an example of a first-class highway of the broadest type, one which was built about 10 years ago over a level expanse between the villages of Langenfeld and Burgwald. The road in question is 2,100 metres (2,324 yards) long and 26½ feet in width, the macadamized wagon track being 13½ feet wide and 8½ inches thick. With labor estimated throughout at 36 cents per day, except for stone masonry which costs in country districts from 60 to 75 cents per day, the construction account of the Langenfeld and Burgwald Chaussée foots up as follows:

Grading roadway	$707.61
Planting and turfing slopes	89.96
Bridges and culverts	154.70
Macadamizing	3,647.35
Markstones, numbers, etc	11.38
Tools	75.68
Damage to adjacent property during work	155.65
Tree planting	61.88
Superintendence of construction	369.85
Incidentals	49.98
Total for 2,100 metres	5,324.24

This is equivalent to about $3,646 per mile.

The above exhibit represents the average cost of converting an ordinary dirt road in a country district into a macadamized chaussée of maximum width and standard quality. From a report published at Guben in 1883, by State Engineer Schultze, the following statistics are copied which show the net cost per running metre of several important

roads which were built under supervision of the author during the period from 1871 to 1882:

Designation.	Length.	Width.		Cost.		
		Whole road.	Carriage way.	Total.	Per running metre.	Equivalent in dollars per mile.
	Metres.	*Metres.*	*Metres.*	*Marks.*	*Mks. pfs.*	
Beeskow Lieberose	20,036	8.79	4.39	138,823	6 93	$2,630
Lubben Lieberose	32,500	8.79	4.39	275,646	8 48	3,224
Friedland Weichensdorf	6,546	9.00	3.75	48,727	7 47	2,838
Ziebingen Furstenberg	13,533	8.50	4.00	115,241	9 67	3,689
Zweinert Goetz	17,680	8.50	4.00	126,113	7 13	2,710
Liebrose-Peitz	6,177	8.79	3.75	59,668	9 66	3,689

In respect to the expense of maintaining well-built roads in this country it is difficult to obtain statistics which prove any definite result. Once built, the cost of keeping a chaussée in repair is in proportion to the weight of traffic which it carries, modified somewhat by the varying quantity of heavy, washing rains which fall and in some cases, notwithstanding all precautions, choke culverts and overflow and damage the roadways. But these accidents are rare and generally trivial, so that the work of keeping a German road in repair consists mainly in replacing with broken stone the material which is ground up by travel and washed off as mud, or blown away as dust.

FRANK H. MASON,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Frankfort-on-the-Main, February 13, 1891.

HAMBURG.

The streets of Hamburg are at present in such a wretched condition that I would not like to recommend any system they use here for any city in the United States.

The press of this city are full of complaints about the paving of streets and the bad condition of the highways. A movement is, however, on foot to secure better streets for the city, and I shall report upon any progress made here in this direction.

CHAS. F. JOHNSON,
Consul.

UNITED STATES CONSULATE,
Hamburg, December 31, 1890.

MAGDEBURG.

REPORT BY COMMERCIAL AGENT WASHBURN, OF MAGDEBURG.

CITY STREETS.

Magdeburg has a population of 180,000. Its streets—city proper and suburbs—are uniformly paved with stone. The particular grade is a kind of porphyry, which is unusually hard and has the advantage of being quarried in the immediate vicinity. In the work of paving two classifications are made:

The first is known as the reihen pflaster (pavement in rows). The stones used for this purpose are required to be of uniform size and of the following dimensions: 7½ inches long, 5½ inches broad, and 7 inches deep. The spaces between the stones are filled with sand. This is the usual pavement in the principal streets. The cost is estimated at $3.425 per square yard.

In those streets where the traffic is exceptionally heavy the foundation is a mixture of gravel, cement, and chalk. Tar is used to fill up the spaces between the stones. Further, the pavement is doubled. This has been found to be especially advisable in the narrow streets, where the wear and tear are necessarily greater.

Streets of the second class are paved with kopfstein pflaster (headstone pavement). The stones called for are of various sizes and dimensions, as broken in the quarry. The method of paving is the same as in the first class. The less important streets are paved in this manner, though it occasionionally happens that some of the principal streets are so paved temporarily. The cost of this construction is about $2.40 per square yard.

All work is done by contract. The original pavements of both classes are always torn up at the end of 2 or 3 years and repaved permanently. This is to correct the unevenness due to settling. The same materials are used and the cost is slight. Experience has shown that, with occasional repairs, streets so relaid last a quarter of a century or more.

COUNTRY ROADS OR HIGHWAYS.

The country roads in this vicinity are always more or less elevated. They are constructed of such material as is nearest at hand and most available. A slight excavation is made where the road is to be built. This cut is filled with gravel, and water sprinkled upon the gravel. Then follows a layer of small pieces of broken stone and gravel and water. This is made compact by repeated rolling. Generally there is a second layer. These roads have all the smoothness and hardness characteristic of the continental highways. It is impossible to give any constant estimate of their cost, for the reason that this largely depends upon the cost of transportation of the material.

Country roads are built or repaired by order of the kreisdirection—a local assembly whose members are elected for definite terms. The official immediately in charge of the roads is the kreisbaumeister. This officer is selected only after special training for the work, and is appointed for life. He generally has several assistants. Reports on the condition of the roads are made from time to time, and the recommendations they contain are usually followed by the local board. It frequently happens that large property owners desiring a road through or near their possessions are called upon to defray the expenses of construction by a special tax. In some of the more sparsely settled districts the roads are built directly by the general government.

ALBERT H. WASHBURN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Magdeburg, January 16, 1890.

PLAUEN, SAXONY.

REPORT BY COMMERCIAL AGENT PETERS.

CITY STREETS.

In the construction of the streets and roads of Plauen, Saxony, one will note two modes, namely, the temporarily constructed streets—streets made for the time being, and the finally constructed streets—streets constructed with a view to leaving them as first put down.

Of late the temporarily made streets are laid at such a depth that they form a foundation for the finally made streets, so that the latter, whether macadamized or paved, may be erected on this foundation.

By the various ways and systems of making roads the lowest section always consists of 10 centimetres of coarse gravel or small broken stone and 15 centimetres of gravel packing.

Construction.—For the foundation of the roads small broken stone and gravel-packing (bottoming) is being used, which is found in the quarries surrounding Plauen.

Macadamizing is done for light traffic with lydian stone (siliceous schist) or foundation stone (grundsteinklarschlag) found in the neighboring quarries, and for heavy traffic with basalt from Waldsassen.

The paving of the finally built roads is done with split granite or syenite, which is furnished by the quarries of Grimma, Schneeberg, and Kirchberg, all three towns of Saxony, as also of Schönbrunn, in Bavaria. The sidewalks, which are temporarily built, are made of gravel and are framed with herborized (slate-clay) slabs, which latter come from Theuma near Plauen. The final building of the sidewalks is done with cement granite or burnt clay slabs, manufactured in the establishments of Fickentzscher of Zwickau, Saxony, and of Meisel of Muldenstein, near Bitterfeld.

The granite slabs for framing these sidewalks are purchased in Kirchenlamitz, Bavaria.

Cost of construction per square metre.—Temporary macadamization with lydian stone including the foundation, but exclusive of earthwork, as digging, etc., 2.50 to 2.80 marks; final macadamization with lydian stone including the foundation, but exclusive of earthwork, as digging etc., 3.20 to 3.60 marks; final macadamization with basalt 4.20 marks; paving with finished blocks, including foundation, 12.50 marks; gravel sidewalks, 0.50 marks, and footpaths with granite slabs, 7.50 marks.

Cost of maintenance per square metre.—The macadamized streets of the city (for one year) for light traffic, 0.50 to 0.60 marks; for medium traffic, 0.80 to 1.20 marks; for heavy traffic, 1.20 to 2.30 marks. Of the so-called communication ways (macadamized); for light traffic and with exposure to the sun, .05 to .08 pfennig; for light traffic without exposure to the sun, .07 to 11 pfennig; for heavy traffic without exposure to the sun, 15 to 20 pfennig.

In stating above costs of maintaining the roads, the expenses incurred by the planting of the trees and the cost of plain footpaths or ditches are not included.

An actual count of road traffic has never taken place here.

The cost of materials delivered at the place where the material is needed is as follows, per cubic metre: Lydian stone (kieselschiefer klarschlag), 7.35 to 7.50 marks; basalt (basaltklarschlag), 12.7 marks; finished paving stones, 7.50 marks; bricks for paving (klinkerplatten), 4.50 marks; granite slabs for framing per running metre, 6.50 marks; slate-clay slabs (fruchtschieferplatten), per running metre, 0.50 marks; gravel packing, 2.50 marks; broken stones, 1.80 marks; gravel, 1.50 to 3.40 marks; according to the distance between the gravel mine and the place where the material is used.

No information can be had here as regards the price of the material before it is made ready for use.

The Government has no especial control over the streets of towns, nor does the Government pay anything towards maintaining them.

COUNTRY ROADS.

Roads and streets beyond the town limits are partly Government roads (Staats-Strassen) partly country roads (Land-Strassen); the former are built by the state, the latter by the villages deriving the benefit of said country roads.

The cost of building the new streets is borne almost entirely by the parties owning and improving the surrounding property; naturally the value of the property affected is increased, but varies according to location.

In many instances property has increased ten and fifteen fold within a few years.

THOMAS W. PETERS,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Plauen, January 29, 1891.

SAXONY.

REPORT BY CONSUL MERRITT, CHEMNITZ.

CONTROLLING SAXON ROADS.

Preliminary, and inasmuch as the subject is one controlled entirely by the "executive" branch of government, it may be deemed advisable to describe the manner of controlling Saxon roads.

The king possesses sole executive power in Saxony. Saxony is a limited monarchy, with an area of 5,776 square miles. Its population is 3,270,579, which shows that, with the exception of Belgium, Saxony is the most densely populated state in the world.

There are four principal divisions or departments of the kingdon. These are called "kreishauptmannschaften," with headquarters as follows: Dresden, Leipzig, Zwickau, and Bautzen. At each city named is an officer called a "kreishauptmann." He is the representative of the king and the department of the interior. He is the chief executive and ministerial officer of his district or department. His powers in some respects are superior to those of a governor of a State in the United States, but his duties are not altogether similar, or, indeed, definable in such a report as this.

Subordinate to the four chief executive representatives of the king, as above related, are twenty-seven important executive officers distributed throughout the kingdom in subdistricts called "Amtshauptmannschaften. Such an officer is called an "Amtshauptmann," and his functions are like those of a "kreishauptmann," but limited to his own district.

The skill, energy, and thorough education, as well as qualification and executive ability of these 27 men is the cause of the splendid government and fine condition of the road system of Saxony. It is without doubt the finest system of roads in the world and is the result of patient toil, extensive experiment, and disciplined attention. Very early in the history of Saxony it appears that the rulers were actively alive to the principles embodied in the next following remarks which constitute this report:

HISTORICAL ROAD NOTES.

A road system is one of the means of facilitating trade and intercourse. The creation of the former is therefore intimately connected with the development of the latter, while the importance and expansion of trade and intercourse are again directly proportionate to the degree of civilization that has been attained. A national or international division of labor would indeed not be possible if existing means of communication did not insure the greatest freedom for the exchange of merchandise and produce, as well as the movement from place to place of individuals.

A systematic and efficient development of the means of intercourse can, of course, be expected only in countries where the chief executive authorities are invested with all the powers necessary for the attainment of this end.

In Germany the beginning of the establishment of a methodical road system is coeval with the development of the principle of recognized sovereignty. During the middle ages effectual progress was much retarded, partly by the lack of unity among the then numerous German States, partly on account of the imperfections of the methods of road-building then in vogue.

The building of turnpikes began to assume great proportions with the beginning of the present century, the first half of which may be justly termed the classic age of the construction of state roads. Government roads were built to connect the various sections of the country with each other and with the adjacent localities of neighboring countries.

Since the introduction and development of railways, the latter have assumed to a greater and greater degree the functions of the road system, as also of the system of canals and other navigable ways. The road system, however, still serves the very important purpose of effecting local intercourse, and of connecting the local freight and passenger traffic with the railway service.

As regards Saxony, the oldest records pertaining to roads deal exclusively with the use and keeping up of certain roads on the part of those interested in commerce and trade, and with prohibiting the use of other roads.

The roads were only occasionally repaired, and then only when their defective condition threatened injury to the interests of the State, or when the complaints as to the impassableness of the road on the part of the traveling public, which was restricted to the use of certain roads, became so emphatic that the equity and necessity became apparent of providing for the people's safety and convenience in return for the tolls they were obliged to pay. The general principle which obtained was that the obligation of keeping up the roads depended on the levying of toll and safeguard * duty on the same, and for that reason the expense of repairing the roads was met principally with the proceeds of the safeguard duty; the coöperation of the cities, the nobles, the parishes, and the owners of realty in keeping up the roads seems always to have been required.

The Saxon princes regarded it as not only their duty to provide for the security of roads on which the safeguard system was not applied,

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* This species of toll was so called because in former times travelers passing over insecure roads leading through forests or thinly settled districts, were escorted by armed knights who levied this safeguard duty in return for their services. However, the duty continued to be collected long after a personal escort had fallen into disuse.

and to superintend those parties on whom by custom or special provision of law the duty of keeping up said roads was incumbent, but also as their prerogative to set aside certain roads for commercial purposes, to levy a duty on the merchandise thereon transported, and, in order to facilitate the collection of this duty, to forbid the trade from making use of any other roads.

The repairing of roads, the keeping up of which was by custom the duty of the State, was done in part by the state roads employés, in part left to those to whom the collection of safeguard duty was farmed out. The necessary timber was taken from the state forests, the hauling and manual labor were performed by the subjects, the necessary money was obtained by the safeguard receipts, or provided by the local state authorities.

However, the condition of the roads, especially during and after the thirty years' war, was far from being satisfactory, and was the subject of repeated popular complaints to the "Landtag" (state legislature).

The orders and instructions issued by the Saxon princes during the seventeenth century first established the rule that the obligation to keep up the roads rested on those who collected safeguard duties thereon, or who were by custom bound to repair. Furthermore, cities were held to keep up the roads within their territory, parishes within their local limits, and where the obligation could be fixed on no other party the repairs were made by the state.

The act of road building was then yet quite simple, and nothing more was aimed at than the construction of a road that would be moderately passable. The obligation of the subjects extended no farther than to the digging of the ditches or gutters, the picking up of fallen timber, the cleaning of the water courses, and the removal of snow from sunken roads.

An order issued about the beginning of the eighteenth century first established the division of roads into main roads and common roads and ways, and provided that the former were to be kept up at the expense of the state; the latter by him on whom the duty devolved by custom.

The width and general nature of the roads were regulated by special provisions; overseers were appointed for the main roads, and commissioners were created with supervisory powers subject to detailed instructions.

It was at this time that gravel, sand, and rock were first substituted for the wood which, in the same manner as American "corduroy" roads, had hitherto been employed in road building, and that orders were given to replace wooden mileposts by substantial milestones, on which the directions and distances of the villages, and especially of the cities, were to be noted. The expenses were to be borne by the respective parishes and by the state for such roads as traversed public lands.

Complaints regarding the defective state of the roads repeated them-

selves with as equally great frequency as did the severe instructions issued to the nobility, the city councils, the parishes, and the subjects, on whom devolved the duty of repairing the roads, to keep their roads and ways in better condition, to clear the ditches, and remove all obstructions, under pain of military execution. During the 7 years' war the roads fell into complete decay, and unusual orders and measures were necessary for the re-establishment of orderly conditions. Thus, for example, to promote and facilitate road building, it was permitted to call out the militia, paying the soldiers a moderate sum, not, however, amounting to the usual day wages.

Road Law of April 28, 1781.

The promulgation of the road law of April 28, 1781, constitutes an important event in the history of road-building in Saxony. The first part of this law treats of the removal of obstructions to road-building; the second, of the ways of carrying on the work of construction; and the third, of the preservation of the roads and of the tools and implements thereunto belonging.

The roads themselves were classed by this law as:

(1) *Military staple and state roads*, or such as had been confirmed by former ordinances and led from one frontier to another, passing through the staple and trading town of Leipzig;

(2) *Interior trade roads*, leading from one trading or market town to another, and serving for lighter freight traffic and for the postal service; and

(3) *Country, town, and local roads*, which served for bringing the products of nature into the cities, and aided in the carrying on of agricultural pursuits.

This law did not affect the obligations of construction and repair heretofore existing. Cities and country parishes continued to be liable for the keeping up of the roads within their respective jurisdictions, outside of which the charge for keeping up the military and state roads devolved either on the state or on him who collected safeguard duties, bridge, and other tolls thereon. The preservation of local and country roads remained the duty of the respective interested parishes.

The direct assistance of the local subjects in repairing such roads as were kept up at state expense was no longer required. Road-building was regarded as a proper concern of the state government, and the principle was established that those on whom the obligation to construct roads was fixed by law were bound to compensate all private land-owners whose land was taken for public road purposes, to the extent of the actual productive value of the land so taken. The proviso was, however, added, that the owner of land adjoining a road must cede the space required for the projected road or the widening of an existing road, without claiming compensation, when the total area thus ceded is less than a certain extent—so much as could be seeded with two pecks of Dresden measure.

The state parliaments annually voted considerable sums for the construction of convenient and durable roads, declaring them to be an essential condition of securing easy intercourse among the people, of facilitating the conveyance of the necessaries of life, of promoting the prosperity of the industries, of trade, and of transportation. It was ordained that the interested parishes should contribute to a reasonable extent not only in the construction of less important roads, but also in that of the main trade roads.

During the course of time the Saxon Government has not only contantly kept its state roads abreast of the latest attainments of engineering art, but has also constructed new roads wherever their need became evident, and where the parishes on account of their financial situation, or for other reasons, could not well be expected to build new roads or ways of such a character as would meet the actual wants of trade.

Present Classification of Roads and Ways.

The old classification of roads into military, staple, and state roads, interior trade roads, and country, town, and local roads gradually lost its significance as the conditions of trade became altered.

The classification which obtains at present is essentially based on the obligation of keeping in repair, and is as follows: (1) State roads (turnpikes); (2) country roads, connecting two or more towns or villages; (3) streets for the accommodation of the interior traffic of cities and towns; (4) private ways.

(1) *State roads.*—All roads that have heretofore been kept up by the state, as well as such roads as have been built by the state either on its own initiative or on the proposition of the interested localities, and which are likewise kept up by the state, are regarded as state roads.

At every session of the "landtag" petitions are received from numerous localities asking for the construction of new roads at state expense. During the last 10 years the rule has gradually been adopted to leave the construction of new roads to the interested localities. As an utmost concession, roads which are to serve primarily for through-trade may be built at state expense, if the parishes benefited thereby furnish the right of way, and, in some instances, obligate themselves to bear a portion of the cost. When finished, the keeping up of these roads becomes a charge on the interested parishes. However, to enable the construction of country roads where greater difficulties have to be overcome than is usually the case with the class of roads kept up at the expense of the parishes and the manors, a certain sum—at present 300,000 marks per annum—voted by the "landtag" for the financial encouragement of road-building is annually distributed by the department of the interior in accordance with the estimates submitted by the proper district authorities.

Some parishes engaged themselves in former times to make regular contributions of money or material on condition of the state's building

a new road, or taking in its charge an existing road, and this obligation remains as about the only case in which parishes are still compelled to contribute to the keeping in repair of state roads. However, a general provision of law requires those parishes that adjoin state roads to furnish the necessary hands for shoveling the snow off the roads and for hauling it away. The state makes a certain allowance for this, which, however, is usually insufficient, so that the parishes must make good the difference out of their own treasuries.

The right of way for new state roads may be condemned by the state on fully indemnifying the respective land-owners. In like manner the owners of land adjacent to proposed roads are obliged to permit the authorities to make use of all such road-building material as may be found on their land, a suitable indemnity being allowed.

Where state roads lead through towns, the state does not undertake the construction of sidewalks, drains, curbstones, and the like, rendered necessary by local conditions.

However, the paving and keeping in repair of the pavement of such portions of the road are at the expense of the state.

The tolls which were formerly collected on the state roads and bridges have been abolished since 1884, partly in view of the satisfactory financial situation of Saxony, partly because of the many inconveniences caused the traveling public, partly also on account of the great expense incident to their collection.

The general supervision and management of the construction of state roads is intrusted to a state road commissioner, the technical direction of the works being in charge of a special officer termed a road director. The local supervision is exercised within the limits of their respective districts by the "Amtshauptmannschaft," which, as before stated, is the chief executive and ministerial office of the district. The direct technical control of the operations, the making of plans and estimates, and the actual construction of roads, are in the hands of "inspectors of roads and navigable ways," whose offices are usually at the seat of the "Amtshauptmannschaft." Every road inspector must have successfully passed the examination for state engineer. When the amount involved does not exceed 600 marks the road inspector may make the estimates, conduct the repairs, or let the contracts himself. For the execution of larger works he must obtain the approval and coöperation of the Amtshauptmannschaft. Road inspectors are aided in their work by assistant road inspectors—usually trained builders—and by a number of state roadmasters. The latter need pass no special examination, and may prove their fitness for the place in some other manner.

The roadmasters are to assist in the preparatory work and in the construction of state roads. They are charged with the immediate direction of the work of keeping the roads of their road district in repair; this not only with reference to the state roads, but also to the country roads, the keeping up of which is at the expense of the vari-

ous localities. When new roads of the latter class are to be built the roadmasters are also charged with the direction of the work. They are assisted by roadguards and by hired day laborers, and are charged with directing and overlooking the work of all persons employed on the roads of their district. They are to give careful attention to maintaining a sufficient number of laborers who are qualified and equipped for road work, and especially to the training of suitable parties for the position of roadguards. Furthermore, they are to exercise due care to insure a strict observance of the road laws on the part of the public, and to keep a watchful eye on their employés in order that the latter may in no wise annoy the public, as for examples by frightening horses.

(2) *Country roads* (*Communicationswege*).—Public roads not state roads are generally termed "connecting" roads in so far as they serve to connect two or more towns.

The road law of January 12, 1870, makes the construction and repair of these roads and of appurtenances such as bridges, ditches, drains, guideposts, etc., the obligation of the parishes through whose territory they lead. In this respect the royal castles, state forests, manors, and other estates not entering into the parish organization are classed as parishes and likewise bound to keep up the roads within their territorial limits, and to construct such new roads as the volume and nature of traffic render necessary.

Passage ways leading from a public road to adjoining parcels of land must be built and kept up by the owners of that land. If, however, the location of a road is changed or a new road established, necessitating a change in the location of the passage way or the construction of a new one, this work thus incidentally occasioned by the parish is to be done by the parish.

When additions are made to the territory of towns or cities, necessitating the construction of new roads, the expense thereof must be borne by the owners of the land forming said additions, the community merely charging itself with the subsequent repairs. The same rule obtains when a change in location of an existing road is rendered necessary by the construction of a railway, the establishment of artificial or the correction of natural water-ways.

Exceptions to the rule that every parish must build and care for the roads within its limits have been generally abolished. They still exist only when founded on special contract, or when coupled with advantages to the obligor, and can be terminated on notice given by either party, full indemnification being made either by the payment of a single lump sum or of a fixed annuity. This applies particularly to the so-called "communities" (Altgemeinden), the original members of which generaly agreed to hold the land in common, dividing the profits among themselves, but undertaking, on the other hand, to keep up the roads of the community without the coöperation of the later arrivals.

When the boundary line between the parishes passes along on a road- each parish keeps up that portion falling within its limits; in case of doubt the expenses of repairing is equally divided. If, however, the boundary merely runs along the side of the road, the duty of keeping in repair devolves wholly on the parish having territorial jurisdiction.

Propositions looking to the construction of new roads, or the chang, ing of the location of existing roads, are to emanate from the interested parishes and manors, who likewise are charged with the management of roads and with the immediate direction of the work of construction and repair.

Supervisory powers are exercised by the "Amtshauptmannschaft," which is charged with the infliction of penalties in case the parishes should prove unfaithful to their trust. But, as a rule, the "Amtshauptmannschaft," after a consideration of the complaints that have been lodged, merely ordains the construction of the necessary new roads, or the thorough overhauling of such as are in defective condition. It is also customary for the "Amtshauptmannschaft" to specify every year the road work that appears to be most urgent.

The jurisdiction of every Saxon "Amtshauptmaunschaft" is coextensive with the limits of a kind of district formed by a union of parishes and for certain purposes. The district owns some district property, manages such affairs as concern several parishes at once, and provides for matters of a common interest for which the resources of the individual parishes are not sufficient. The district board is charged with the supervision and encouragement of country roads, and usually strives to attain the desired results by assisting the poorer parishes in defraying the expenses of construction and repair with the accumulated increment of the district's property, also by undertaking to keep up certain roads which accommodate the through trade as district roads at the expense of the district; in some cases also by employing a salaried district roadmaster to assist the "amtshauptmannschaft" in the control and supervision of country roads, and to perform, with reference to these, duties similar to those devolving on the state roadmasters with reference to the state roads.

When it is the desire of a parish to discontinue a certain road, that is to withdraw it from public use, the "Amtshauptmannschaft" must be notified and makes public announcement of the intended discontinuance, summoning all parties who might have objections thereto to make them known within a fixed time. At the expiration of this term the "Amtshauptmannschaft," in conjunction with a committee composed of city and parish delegates and the highest tax-payers of the district, decides whether the proposed discontinuance is to be approved as in the interests of the public or whether it is to be rejected.

If a dispute arises as to whether a road is public or private, the question is decided, after due examination, by the "amtshauptmannschaft" and the district committee. A road is considered as public when it

has been in unobstructed public use for at least 30 years. It is presumed to be public when returned by the state land survey as exempt of taxation and entered as a public road on the parish record.

Cart-roads and foot-paths differ primarily in the use to which they are put. As to the width and nature of these species of highways the law provides that cart-roads must have a width of not less than 7 metres in towns, and 5 metres in the open country, clear of ditches, if any, and that foot-paths are to have a width of 1 metre.

Every parish is left free to determine itself the manner of raising the means for defraying that part of the expense of construction and repair of roads and ways which is not provided for by the state or the district. Some parishes have been authorized by the state or the district to levy tolls on certain roads serving principally for through transit, in order thus to meet part of the expense. These tolls are still collected, though they have been abolished on the state roads.

Owners of forests, rock quarries, factories, mills, and the like, who use roads on which toll is not permitted to be levied, for the carrying on of their business to such an extent as to cause a material part of the wear and tear, or to make necessary more frequent and more thorough repairs than would otherwise be required, can be held to the payment of a special sum, in proportion to the expense thus occasioned to the parish. In case of dispute, the amount of this special contribution is fixed by the "amtshauptmannschaften" in accordance with the judgment of experts.

(3) *Streets.*—Most of the provisions applicable to country roads apply also to village streets. As a rule the construction and repair of the streets are to be borne by the parish. However, when additions are made to a town necessitating the construction of new streets to connect the new addition with the older portion of the town, or to connect the different parts of the new addition with each other, the parish in authorizing the admission of the new territory may require the owners of the land embraced therein to furnish the necessary rights of way free of charge, or even to construct the new roads themselves, the parish merely assuming the subsequent repairs. Nowadays the latter mode has been generally adopted by cities and populous parishes; the rule is that whoever seeks to convert acre property into building lots must construct the necessary streets, bridges, culverts, etc., and transfer them to the city gratuitously, together with the title to the soil. These roads, etc., must extend the full width which the lots on which it is intended to build front on the projected roads, counting not only the width of the house, but also the gardens, courtyards, etc., and are to be carried to their junction with other projected or existing roads.

If the land composing the addition is the property of different owners, the one building first must construct the necessary roads, but as soon as the others begin to build they must pay the former or his heirs or successors a pro rata sum, depending on the width of their lots which front on the new roads.

It is usually provided in the city building ordinances that when the public interests require the continuation, widening, or correction of streets, ways, or public squares, or the construction of new ones, or the building or widening of bridges, levees or dikes, or the construction of culverts or drains, the owners of the land adjoining the proposed works are required to allow the authorities to make all proper use of their land—even though it be covered with buildings—and to cede to the city such portions as are needed, in consideration of a reasonable indemnification.

Before, however, private property can be taken for public purposes in this manner, the department of the interior must have declared it to be in the interests of the public and must have authorized the necessary condemnations.

(4) *Private ways.*—Private ways, built by land-owners on their own land in order to facilitate the cultivation and use thereof, are not subject to any ministerial regulations, being properly objects of private law. Only in so far as they may give rise to considerations of a general police nature, would it become the right and duty of the authorities to occupy themselves therewith and to issue instructions relating thereto.

As a principle of common law the rule obtains that the owner of a tract of land may require his neighbors to permit him to pass over their land, granting him a so-called "way of necessity" when without such way of necessity the cultivation of his land would be impossible, or when the establishment of a different way than the one he asks for, or the use of another existing way, would be attended by difficulties out of all proportion to the profits yielded by the land. Reasonable compensation must be made for the use of such a way.

An arbitrary change in the manner of using the land, or the mere personal convenience of its owner, do not entitle the latter to demand a way of necessity. Such easements are to be limited to the actual necessity, and their location and direction are to be determined in order that, on the one hand, the servient tenement may suffer the least possible damage, and that, on the other, the expense to the owner of the dominant tenement may not become unreasonably great.

CONSTRUCTION AND REPAIR OF STATE ROADS.

No new instructions have been recently issued regarding the rules to be observed in the construction of new state roads. There is no necessity for general instructions on this subject, as such roads are always built in accordance with plans prepared by the state engineers, based on a due consideration of the local needs and of the available funds; and as a these plans must first be examined and approved by the highest road authorities, the latter always have the opportunity of prescribing such special directions as former experience and the latest developments in the act of road-building seem to render advisable.

A circular instruction issued by the department of the interior several years ago, and addressed to the parishes, though dealing primarily with the country roads—which are not state roads—serves to give an approximate idea as to what, in the eyes of the state, are the essential elements of a satisfactory and methodical road system.

According to this circular, every road is to consist of a rock substructure and of a rock superstructure. The former supports the latter and prevents its sinking into the ground.

The superstructure constitutes the wearing surface of the road; it protects the substructure against wear as well as against the penetration of dampness with its injurious effects. The material employed should always be the best that can be obtained in the respective localities, the best varieties of rock being basalt, porphyry, finely-grained granite, and clear quartz.

The rock substructure—foundation—is to consist of broken stone, carefully placed by hand on the smoothed and graded roadbed, and to have a height of 12 centimetres if the rock is hard, and of 15 centimetres if it is soft. The pieces of broken stone are to be as nearly as possible of equal size, and are to be placed tightly against each other, each one with its largest plain surface downwards to prevent its working loose. The intervening spaces are filled up with small fragments, carefully wedged in and rammed down.

On this foundation is placed a superstructure consisting of a layer of 8 to 10 centimetres depth of small broken stone, the pieces as nearly as may be of equal size, or of gravel. In order to obtain a surface as smooth as possible the broken stone composing the superstructure should approach a cubical form as nearly as may be, and should be of the size of a hen's egg or a walnut, depending on the quality of the material. The road is next thoroughly soaked with water, and passed over several times with a heavy roller. It then receives a covering of fine gravel or pebbles, and is solidified by careful rolling.

In order to secure a rapid drainage of the road and to keep the roadbed dry, the surface must be convex—a central elevation of one-sixteenth to one-eighteenth of the half width of the road being sufficient—and the road must be provided with ditches on both sides, having a depth of not less than 0.3 metres and a width at the bottom of 0.3 metres. In level country the grade of the road should never exceed one-fourth inch, and in mountains one-twelfth inch. At heavy curves the road should be as level as possible, and its width should be increased by one-fourth to one-half.

The rules to be observed in keeping the public roads in repair have been quite fully set forth, partly in the form of general instructions, partly as specific regulations issued to the road employés.

A distinction is made between general repairs, undertaken to make good the deterioration of the entire roadbed by the action of the weather and traffic, and local repairs, which are continually necessary to correct

the partial wearing out of the surface by mechanical action, as evidenced in the form of ruts and depressions.

General repairs consist in covering the entire surface of the road with a massive layer of broken stone, which is thoroughly rolled down so as to fill out all depressions. When a considerable portion of a road is to be covered with new material, the work is to be performed in short sections if the street is narrow; if wide, the material is to be spread in narrow longitudinal strips, so that not more than one-half the width of the road is being worked at the same time, and only when the first half is completed is the second to be begun. The road, when thus covered with new material, is to receive a suitable covering, which however, is not to be applied until the mass of rock has been sufficiently rolled to acquire a certain degree of solidity and to cause the intervening spaces to disappear.

As has been stated, a street-roller is employed for compressing the mass of broken rock. The rolling is done longitudinally, moving gradually from the edges toward the center, and, when practicable, is to be kept up until the mass of new matter is thoroughly fixed. The mass is to be moistened by continued sprinkling, in order to insure its more perfect solidification. It has been found that the seasons best adapted for making general repairs are the spring months until the middle or end of June, and the months of September and October. The winter months are not advantageous, even though the weather be mild, for it has been found to be an essential condition of durability that the new material be thoroughly dried and hardened before it is subjected to the action of the frost.

The frequency with which general repairs need be made is variable, but averages for the state roads from 11 to 12 years.

In order to insure the greatest possible durability of the road surface, care should be taken that the covering of new material be not too thin at places. The old road surface should therefore be specially prepared for the reception of the new covering by paring down the protuberances and carefully reëstablishing the profile.

When general repairs have been made, the surface of the road usually remains quite smooth for years if the traffic is but moderate. However, more or less unevenness develops in the course of time, and to counteract the formation and enlarging of rough spots as much as possible is the chief object of the continuous local repairs.

Finely-broken rock, either specially prepared or obtained by sifting the coarser material intended for road covering, is employed for making the local repairs. Depressions in the road are filled up not only to preserve the smoothness, but also because vehicles avoid such defective spots and thus wear out the rest of the surface all the quicker. For this reason the places to be repaired are to be selected in such a manner as will tend to a uniform wearing of the whole road surface. As a further means of obtaining the latter result, the track to be followed by

vehicles may be fixed by placing obstructing stones * on the road, which, however, must be removed at night. This is to be done only in damp weather, on roads used for heavy hauling, and then only to a limited extent at a time.

When defects can be remedied with a small quantity of new matter it is sometimes advantageous to loosen the edges with a pick, in order to obtain a thorough union with the old and new material. The loose matter should be moistened and carefully rammed down and covered over. This method is, however, employed to a limited extent only, as it is rather expensive. Local repairs should always be carefully conducted in order that the solidification may take place as speedily as practicable. They should for the same reason never be undertaken for a large stretch of road at a time, so that, if dry weather should set in, delaying the process of consolidation, the traffic may not be unduly interfered with.

Not until the mass of material spread at the last general overhauling has practically disappeared are general repairs again necessary. As the surface does not wear off uniformly, the smoothness of the road has usually suffered material diminution before a new overhauling is undertaken. In some instances the system of repair here outlined proves insufficient, even though the road be otherwise strong enough. Thus, in villages where the road is well built up the street crossings are used by large numbers of pedestrians, who, as a rule, are more exacting as to the condition of roads, especially in wet weather, than the drivers of vehicles. In such cases a stone pavement or some other substantial substitute for the macadamized surface becomes necessary.

If, however, the road itself is lacking in power of resistance, it is necessary to strengthen the roadbed and at the same time take measures looking to a uniform wearing off of the entire road surface.

Where the traffic is neither large nor heavy, and the defects of the roads are unimportant, the movement of vehicles will not be apt to suffer in case of bad weather, and even if affected, it will be for a short time only. In such cases it will be sufficient to aim at maintaining the *status quo* by providing somewhat more new material than will equal the amount worn off, thus counteracting the deterioration of the roadbed resulting from the occasional interruption of the continuity of repairs.

If, on the other hand, the vehicles passing are both heavy and numerous, and the defects of the road more serious, interruptions of communications are to be looked for more frequently and are apt to be of longer duration and greater importance. In such cases it is plainly imperative to try to restore normal conditions as speedily as may

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* The dimensions of these obstructing stones should be one-third metre. To make them easily visible, they are to be painted white. They are to be placed on the road in such a manner as to keep the traffic off that portion of the road which it is the desire to withdraw from public use.

be. This applies especially to roads whose defective portions are of but small extent, and to such as suddenly become quite or wholly impassable. Cases falling between the two extremes cited must be met according to circumstances. It may be advisable at times to refrain from any attempt looking to a complete restoration, merely striving to limit the extent of the defects.

As to the manner of procedure to give the roadbed greater power of resistance, it has been found that increasing the thickness of the superstructure, or merely renewing it with greater frequency, is the simplest method and accomplished with the least interruptions of traffic. In so far as new material is used merely to increase the thickness of the superstructure without being exposed to surface wear, a substance of moderate quality will answer, the better and more expensive material being reserved for the surface covering.

Where, however, the roadb ed contains springs the method above set forth is not always effective; it is generally necessary to secure better drainage by widening and deepening the ditches, and digging new ones, if there are not already enough. Underground drainage is now being introduced for such cases, a trench of 0.4 to 0.6 metre in width being run longitudinally under the center of the road, and filled up with loose stone and rough gravel to the rock superstructure of the road. Tranverse trenches from 0.3 to 0.4 metre in width serve to conduct the water out of the roadbed.

Even in this way a complete success has not always been attained. Some kinds of soil are not sufficiently porous to admit of thorough drainage in this manner. In many cases, too, the deficient depth of the ditches renders it difficult to locate the drains at a sufficient depth and at the same time permit the water to flow out into the ditches. Accordingly, when a system of underground drainage promises but incomplete success it will be well to combine with it a reënforcement of the superstructure of the road, in some cases even to construct a new roadbed supplied with extra thickness of rock layers.

If, however, as happens in the most difficult cases, the level of the roads makes satisfactory drainage impossible, a complete success can not be achieved without changing the level, or, what amounts to the same, entirely rebuilding that section of the road.

When it is the intention to pave certain portions of a road, care must be taken to give the substructure the necessary strength and solidity.

The detailed instructions issued for the guidance of the roads employés are in accordance with the general rules as above set forth.

It is the duty of the roadguards to carefully ram down all newly spread material that has not yet been thoroughly fixed. If in places the material was not sufficient, and ruts again make their appearance, the guard is likewise to apply new matter with proper care. He is to pare down all ridges and projections, and work the loose matter into the depressions, in order that the road may be smooth and retain its

original convexity, and if necessary he is to put on enough new material to attain this end. The mud gathering on the road is to be carefully scraped off, especially when a spell of wet weather sets in. The dust that accumulates in dry weather is likewise to be removed, care being taken to pick out the loose stones. The guard is furthermore to stop up all holes in the body of the road or the sides of the ditches, using for this purpose the mud that has been scraped off the road, to clean the ditches, destroy the weeds that make their appearance on the roadside, keep the bridges and culverts unobstructed and in good condition, open the drains and put them into repair.

When snow has fallen heavily or is drifting, the roadguard must shovel it off the road so as to keep a track open. If he is unable to do this with the assistance of hired day laborers, he must make requisition on the parish authorities for the necessary help. If, on account of continued drifting, the road can not be kept open, the travel is to be temporarily led over the adjoining fields, care being taken to mark the location of the temporary road by poles and wisps of straw. When the weather permits sleighing for some time, loose stones and gravel liable to cause accidents are to be removed, and bare spots are to be covered with snow.

When thaw sets in, all snow and ice on the roads must be speedily removed.

Another though comparatively subordinate charge on the road authorities is the planting of trees along the road and taking care of them. As a general rule, trees must be planted along every road.

This is done partly to render the direction and the limits of the road more plainly visible in the dark and when the snow is drifting, partly to delight the traveling public. In the choice of trees to be planted climatic conditions merit first consideration, attention being, however, also given toward securing the greatest possible returns from the trees. For this reason fruit trees are preferred wherever practicable, otherwise those forest trees whose wood has the greatest commercial value.

In so far as professional knowledge is not required, the roadguards are also charged with the pruning, removal of insects, clearing of tree frames, watering those newly set out, and replacing those that fail to take root.

CONSTRUCTION AND REPAIR OF COUNTRY ROADS.

The rules governing parishes in the construction of country roads have been stated in the course of the remarks on state roads, to which reference is therefore made.

The circular to which reference has already been made also states the general rules to be observed in the repair of country roads in terms analogous to those concerning the repair of state roads. However, it does not contain fixed instructions which must be obeyed under all circumstances, but is rather a statement of facts and principles for the information of all concerned.

Specific instructions are issued by the "Amtshauptmannschaft" to meet the particular requirements of the individual cases of "country road" construction and repair. The only general provisions have been already set forth and concern the width of the street, the planting of trees wherever practicable, and in the default thereof the marking of the limits of the roads in some other permanent manner which may be efficient, especially in time of snow.

CONSTRUCTION AND REPAIR OF STREETS.

It is left to the individual parishes to regulate the construction and repair of their respective town and village streets. Of course the necessity of establishing special ordinances regarding streets exists only in the cities and populous parishes that have an extensive local traffic, and the nature of these ordinances varies with the varying local conditions. A general provision, however, requires streets to be composed of a substantial rock substructure and superstructure and of a suitable covering, the latter to consist of large flat rocks for the sidewalks. It hardly could be of interest to enter into the details of these ordinances. For those parts of city streets where wagons pass, the varied materials such as Belgian blocks, cobblestones, Nicholson pavement, asphalt, pressed slag, etc., are used for surface as they are in the United States. The manner of putting the materials used in the construction of city streets does not differ from that of our American cities.

Water and gas pipes are laid, and sewers, catch-basins, fireplugs, and manholes are constructed and placed similarly to the manner adopted in the United States. An extended report on city streets will be furnished at a later period if desired.

CULTIVATION OF TREES ON ROADS IN SAXONY.

The system of tree culture along the roads of Saxony is the admiration of every American who observes it. The beauty and picturesque appearance of long avenues of finely-selected and well-kept trees, stretching away for miles in various directions, gladdens the heart of every admirer of natural beauty. It is, as has been stated, a consideration of less importance than the building of the roads, but the following figures will show the value of a well governed and faithfully managed system of tree culture on the public highways.

In the year 1890 the noteworthy sum of 150,622.55 marks was obtained for the fruit grown along the state roads of Saxony. The district which collected the largest amount was the "Amtshauptmannschaft" Döbeln, which turned into the treasury 27,534.50 marks, while the mountain district, Annaberg, supplied the least, or only 15.50 marks.

The revenues from the fruit trees of the other districts was as follows:

	Marks.		Marks.
Pirna, I and II	21,713.90	Zittau	8,853.50
Grimma	18,077.65	Zwickau	6,538.20
Leipzig	17,216.00	Chemnitz	5,178.50
Bautzen	15,733.50	Freiberg	1,046.50
Dresden, I and II	15,638.50	Plauen	970.30
Meissen, I and II	11,536.95	Schwarzenberg	570.00

These figures refer to the state roads only. The income from trees along country roads is greater.

At the risk of repeating a few ideas which have been previously expressed in more general terms, I submit the following:

Object of planting trees.—Trees along the public roads make the border of the road discernible at night, as well as after snowdrifts, thereby warning the public against embankments and other danger along the sides of the road. Trees also afford pleasure and comfort to those who use the roads, and are a source of considerable revenue when properly cared for, as shown above.

In this connection care must be taken to secure the highest possible profit out of such trees in the interest of the road administration and the tax-paying public generally.

Selection of trees.—(1) In general such kinds of trees should be selected for road purposes, which, as far as the climate and condition of the soil permit, promise a good and speedy growth; that are not too sensitive to climatic and other influences and can soon stand without a prop, and that especially promise a remunerative return in proportion to the cost of their raising and nursing.

(2) In parts of the country where fruit trees grow, and where the crop is not in danger of damage by late spring frosts, such trees should by all means be cultivated. Forest trees are preferable where fruit trees can not be grown successfully, especially at high altitudes, and in forests, and also where wanton damage and considerable plundering of fruit may be apprehended, this being sometimes the case within and around thickly populated districts and near villages.

(3) In damp localities trees with broad thick foliage, and on narrow roads short-stemmed trees with wide extending branches should not be planted.

(4) It is also advisable, if possible, to avoid the planting of such kinds of trees as would prove to be directly injurious to the adjoining property.

(5) With special reference to fruit trees, the planting of such trees is recommended as bloom and ripen late, and the fruits of which will stand a long journey and will keep comparatively a long time without spoiling. In order to facilitate the leasing of such fruit trees it is recommended to cultivate the same kind of fruit on rather long stretches of road. In case special local conditions do not make this appear profitable, such varieties of fruit should be planted as will at least ripen at

the same time and always in such number that a proper and reasonable use may be made of the crop and a favorable leasing rendered practicable. Avoid, if possible, the planting of timber trees in between fruit trees.

(6) If apple trees are planted varieties having long stems and lofty tops should be used, if possible. It is not recommended to plant trees in deep or narrow valleys.

(7) For timber trees such kinds should be given preference as can be profitably used for choice woods for special purposes. In Saxony the planting of ash and maple trees, and, in considerable distance from villages, wild cherry trees is specially noticeable. Where the soil is unfavorable, especially in mountainous districts where other kinds of trees do not grow as well, mountain ash trees may be recommended.

(8) Generally speaking, particular attention should be given to young, strong, and well nursed fruit trees of such pedigree as are best adapted to a given part of the country.

(9) If trees have been cultivated which do not correspond with the principles laid down in Nos. 1 to 7, endeavor by degrees to substitute a more preferable system of transplanting.

(10) For such renewal of trees a systematic plan must be adopted and followed with all the supplements rendered necessary in Part V of these instructions.

(11) A change in the system of planting is not objectionable in cases where existing fruit trees can be expected to yield a larger crop by removing timber trees growing between the fruit trees and also barren fruit trees.

(12) When it is ascertained that a change in the kind of trees will cause a more remunerative crop, which will outweigh the costs and damages of the change, the same can be brought about little by little annually on stretches from 5 to 10 kilometers of road. A radical change should always be justified by circumstances, as such a course is unusual, and the same should be explained by a detailed statement made to the chief supervisors of the roads in the district.

Rules of tree cultivation.—The distance between the trees should be based upon the purposes mentioned in Part I. It should, however, not be too small in order not to injure the growth of the trees. When the security of the traffic does not demand a closer planting, apple, pear, and sweet cherry trees should stand 30 to 40 yards apart; sour cherry trees and plums 7 to 9 yards.

Local conditions govern the planting of trees along certain parts of the roads where tree planting appears impracticable, because of the roadsides being abrupt and rocky, or when trees or houses stand in immediate vicinity of the road.

When trees are set out hollow places should be left at their bases for irrigating and other purposes, which should not be too small. Where trees already stand and these "hollows" are wanting, they should be

gradually formed by suspending the periodical trimming of the edge of the road or by banking up a basin-like substitute therefor.

The holes for planting the trees should not be too small, especially when the road lies in a cut or when the planting is to be done on spots where other trees have stood formerly. The holes should be, for fruit trees, from 3 to 4½ feet wide when the soil is rich, and 5 feet when the soil is inferior. The depth should be according to the good or inferior soil: 2 to 3 feet, less than 1½ feet only being practicable for plum trees. Where these holes can not be dug in the prescribed dimensions, then they should be dug out in shape of a ditch, so that the roots of the tree can at least find loose soil in two directions. These holes should be filled with earth mixed with compost.

Should a renewal in the planting on long distances be found necessary, the new trees should be planted between the spots where the old trees stood, and eventually the kind of tree changed.

The poles destined to prop up the young trees should be polished and blunted on the upper end, in order to prevent them from rubbing against the trees. These poles should be fixed on the side which is mostly exposed to strong winds; it must, however, also be borne in mind that these poles protect the trees from damage from the road. The bands should always be attached in the shape of an **8**, and, when fastened, special care should be taken to prevent the pole from rubbing on the tree.

When grafted fruit trees are to be used care should be taken that the desired species be obtained under guaranty. In cases of extensive plantings, when the desired species can not be obtained with certainty, it is recommended to plant wild trees that can be properly grafted when the time comes.

The trees should neither be planted in damp nor cold weather, but in weather when the soil that has been prepared crumbles easily, and therefore can be easily placed between the roots. Apples and pears can be planted in spring as well as in autumn; for cherries and plums, spring is preferable. The latter only require alluvial "mud dressing." When setting out trees the sinking of the soil must be taken into consideration if the same is specially heavy. The tree must not be put as deep in the earth as it grew originally, so that the proper depth of planting is not surpassed by the gradual sinking of the soil around the roots. When the new trees are tied to posts, care must be taken that they are not prevented from settling themselves firmly in the soil. The final fastening to props can only be done when the earth surrounding the roots has settled down.

Nursing and keeping trees.—When dry weather prevails the tree "hollows" should be covered with moss, inverted sod, or similar substances. Newly transplanted and young trees should be provided with the necessary moisture by flooding water into the "hollows," if this does not cause a too heavy expenditure. Where the tree "hollows"

are very small or are completely wanting, two or three holes should be dug around the tree and filled with water. These holes must be kept open with drainage tubes.

To protect young trees against rabbits and hares in winter, or other damages, the stems should be tied up with thorns, straw, or reeds. Wire should be used for this purpose. To protect the trees against insects and to prevent the bursting of the bark in winter, the stems of the fruit trees should in the fall of the year be whitewashed, or covered with a mixture of lime and ox blood, compost, clay, or similar substance. A straw or moss covering is considered a good protection against the drying out of young trees that are especially exposed to the sun and wind.

The earth in tree "hollows," especially those of younger fruit trees, should be frequently loosened.

The so-called "suckers" should be cut off at all times, if they are not required to fill out the tree top or for substitution in places of old boughs. In the latter case they should be nursed with special care. In order to cause a good growth of the fruit-bearing top of fruit trees, careful pruning is necessary at certain periods, as well as a clearing of old trees from useless or too numerous branches.

In general, the nursing of trees along state roads should not suffer by comparison with trees along the roads kept up by communities or private individuals.

The cutting of the young fruit trees should only be done by specially skillful persons. Such employés as have been educated for such purposes are to be preferred.

The pruning of fruit-bearing trees may be done by inexperienced employés when such work is superintended by experts.

Cutting down of trees.—The cutting down of either fruit or forest trees on roads is permitted only when such a proceeding promises to be profitable, with reference to a subsequent increase in the value of the timber trees to be substituted for those removed, or in the value of future fruit crops. The costs of replacing and cultivating young trees must be carefully considered.

The ornamental point of view should not be overlooked, especially on avenues of trees that beautify that part of the country where they exist. Such trees should not be cut down without the knowledge and the consent of the county commissioners.

Dead or badly damaged trees which destroy the beauty of the avenue and which, being liable to break down in storms, threaten to interfere with the proper use of the road, should be removed without delay.

The trees should be cut down in a season in which the wood can be most profitably used.

Wherever trees insure the safety of the roads a renewal of removed or dead trees should take place without delay. If replanting is not

practicable, on account of the season, poles should temporarily replace the trees.

General instructions.—Special care must be taken to secure in time the necessary quantity of trees to be used each season.

Road employés should not be permitted to lease fruit trees or to buy the wood, except in cases where other parties fail to make bids which are satisfactory.

State-road fruit trees are leased to the highest bidders and the money received is covered into the state treasury. Wood from road trees is sold at auction and the money returned to the public treasury. Nothing is lost or wasted, and those who lease fruit trees are held to a strict account for any damage done the trees. Ladders must be used to gather the fruit, and any battering of the trees with clubs or poles to get fruit is sharply punished.

GENERALIZATIONS.

In conclusion, it will not be inappropriate to mention some general facts of more or less importance which have been omitted from the foregoing, and to review briefly some provisions of the laws by which, in the interests of the general public, the executive governing powers seek to prevent certain of the damages which might otherwise ensue.

There are no statistics which show the total length of the combined roads and streets of the Kingdom of Saxony.

Of state roads there are 37,032 kilometres. The average cost per annum of keeping the state roads in the splendid condition which always exists is 650 marks per kilometre, while the beautiful macadamized country roads require an average annual expenditure of 400 marks per kilometre to maintain their never-failing excellence.

These figures do not include the salaries of the employés who protect and tend the roads. The following salaries are paid to road employés:

	Marks.
Road inspectors	3,300 to 4,800
Road masters	1,500 to 1,800
Road guards	660 to 720

Laborers receive about 75 cents per day. Road masters and guards are gratuitously uniformed and are allowed 80 to 90 marks per annum with which to keep their uniforms in repair. They present a neat appearance, and are careful in the discharge of their duties.

The rollers or surface crushers in use are for both horse and steam power. The horse-power rollers weigh from 12,000 to 15,000 pounds and cost from $350 to $400. Gruson steel tires cost $100 extra. The steam rollers are built after the system of Arding & Porter, of Rochester, and weigh 22,000 pounds. They cost $3,000. Heavier rollers are not practicable because of the hilly condition of the country.

None of the roads in Saxony are fenced. They are so clearly defined by the trees which grow along their sides, and by other boundaries,

that fencing is unncessary. In this connection I will report that, with the exception of a few picketed inclosures, there are no fenced grounds in all Saxony.

The charming appearance of this Kingdom owes much of its beauty to the fact that its wide, well-tilled valleys, its rolling hills crested with dark pine forests, and its fruitful plains are not disfigured by fences of any kind.

If the same economy were practiced in the United States our people would be much richer, for it is a fact that the farm fences (road and line) cost more than all the farm buildings in our land.

Even the railways in Saxony are unfenced. Crossings on the level are guarded by descending barriers, even in the places remote from towns and villages. Only on such railways as are narrow gauge and called "secundär" railroads, it is possible to find level crossings which are unguarded by employés hired and paid by the railroads. In such places warning signs and the locomotive bell guard the traveler on the turnpike.

On all wagon roads where steep, abrupt embankments endanger passengers or teams of horses, a barricade is usually built of stone posts connected with heavy angle-iron bolted firmly into place.

Square cut stones show distances in kilometres and fractions thereof. These posts are painted white, and the figures on them are carved deeply.

At crossing or diverging ways substantial iron direction plates tell the distances to various towns or hamlets. In the highlands and mountainous parts a society, called the Austro-German Tourists' Club, has erected hundreds of guideboards for the use of its members and others who are making tours afoot through the enticing and picturesque parts of the country.

There are no special rules giving to pedestrians' rights of way over conveyances of any kind. Drivers must, however, keep off that part of the road which is reserved for and made use of by foot passengers. Horses must be turned to the right when meeting, and several penal regulations prohibit fast driving or any reckless behavior on the roads.

Not only the Royal Government, but all local police authorities hold a firm check on any disregard of general rights which the public enjoy in the use of the Saxon roads.

All wagons must carry a lighted lantern at night, and keep to the right-hand side of the road. All wagons used for heavy teaming are required to be conspicuously and plainly marked in large and durable letters, with the name and residence of the owner. Horses must be driven under control of "crossed reins" as in America, and only when engaged in field work are they not subject to this regulation.

Wheelmen are not granted any special rights on roads. On the contrary, they are required to ride with the utmost caution and care.

In detail, according to differing local conditions the instructions to wheelmen differ as far as police regulations apply. But, in general, wheelmen are subject to the same rules as apply to drivers of horses. They must provide lamps for their wheels; keep to the right; carry a metal shield on the front of the wheel with name and address engraved on it; keep off the footpaths; ring a bell when approaching any one, and in some cases abstain from riding side by side. When riding in files a given distance must intervene between them and those who precede them. Wheelmen, as such, pay no taxes.

Fines collected for the violation of road laws go into the treasury of the authority which imposes the fines. On state roads the money would go to the uses of the "Amtshauptmannschaften," and on country roads to the local police fund.

On some state roads heavily-laden vehicles are required to have a certain minimum width of tire, while wagons having boltheads or screws protruding from the tire, or having tires with a rounded surface, are not permitted to enter the road at all. Drivers of heavily-loaded wagons pursuing a track already well worn must drive on a different part of the road when so directed by any of the road employés.

It is further prohibited to drive in or across ditches or on the footpaths, or to ride, or to drive cattle at these places, as also to drag on the road timber, farm implements, or other articles that damage the surface of the road, or to do any other act injurious to a public road or its appurtenances. A fixed width of tire to correspond to the weight of the load is also sometimes required by local police regulations.

While a violation of the above regulations constitutes merely an offense cognizable by a police court, the willful destruction or injury of roads, or of the trees thereunto belonging, is regarded as a misdemeanor punishable by the proper court.

H. F. MERRITT,
Consul.

UNITED STATES CONSULATE.
Chemnitz, April 10, 1891.

SAXONY.

REPORT BY CONSUL PALMER, OF DRESDEN.

INTRODUCTION.

The division of the public roads in the kingdom of Saxony into city streets and country roads is rendered necessary not only by the fact that their construction and method of maintenance are entirely different, but also because they are under the control of two administrations that are strictly independent of each other.

It will be sufficient to furnish a detailed report on streets in larger cities (in this case Dresden being selected), for the reason that, usually, the streets in smaller towns and villages are built on the same principle as the less important streets in large cities, and further because the same administrative laws and regulations prevail in larger cities as in smaller towns.

The roads in the open country are divided into two classes: (1) State or governmont roads. (2) Country or communication roads (connecting two or more towns or villages). The former are maintained at the cost of the state, by a special department, which also supervises the navigable ways. The latter are built and maintained by the city and country communities, and by the owners of independent estates whose lands they cross; in some cases, also, by all parishes within one "amtshauptmannschaft" (district commission) voluntarily united for that purpose.

The "communication" roads are, ordinarily, used for smaller traffic and serve mostly for agricultural purposes. Their system of construction and repair is in no way different from that of state roads and they may safely be classed with inferior state roads. For this reason no special description will be given of these roads, but, as far as it will appear necessary, they may be referred to occasionally.

In the entire kingdom of Saxony no distinction is made between roads for light and such for heavy vehicles. The public roads are, in general, open to traffic of every description, and therefore they should be built and maintained in accordance with such requirements. In the city of Dresden the transportation of heavy loads that can not be separated is only permitted under the condition that such vehicle be tested by officials in reference to its loading capacity, and that the condition of the foundation, sewerage, etc., of the streets through which such heavy loads are destined to pass be thoroughly examined.

Similar regulations exist in reference to state roads and for crossing over bridges.

CITY STREETS.

The primary difference between city streets and country roads consists in their different manner of drainage. The latter are drained by means of longitudinal ditches on each side of the road, the former only by underground sewers located in most cases in the middle of the street. These sewers not only serve to drain all waste water from the houses without detriment to the inhabitants, but also make it possible to provide the street with elevated sidewalks.

Beyond this the constant traffic in cities, and care for the health of the inhabitants requires a far greater durability and solidity of construction of city streets and sidewalks, and more care must be bestowed on their maintenance than is the case on country roads. Almost all city streets in Saxony are paved.

Recently, beaten asphalt is being used in the busiest streets of larger cities instead of stone pavement. Wood pavement was also tried, but did not fully meet the expectations, and after several trials this system was altogether abandoned, the wood was removed and replaced by asphalt.

In parts of cities where there are only detached residences (villas) macadamized roads are preferred.

COST OF MATERIALS.—The cost of materials for street and road building, exclusive of all costs of transportation from the different quarries may be averaged as follows:

Rough paving stones from the quarries of Planeusche Grund, from Pennrich, and Prabschütz, 2.70 marks per square metre equal to 2.25 marks per square yard.

Rough paving stones from the quarries near Meissen, from Schönborn and Demitz, 2.15 marks per square metre equal to 1.80 marks per square yard.

Dressed paving stone from the quarries of Luptitz and Grimma, Dornreichenbach and Haida: first class, 6.75 marks per square metre, equal to 5.65 marks per square yard; second class, 6.35 marks per square metre, equal to 5.30 marks per square yard; third class, 5.45 marks per square metre, equal to 4.55 marks per square yard.

Dressed paving stones of all three classes from quarries Bullevitz and Niederiocesa, 8.60 marks per square metre, equal to 7.20 marks per square yard.

Cast slag paving stones, 3.80 marks per square metre, equal to 3.15 marks per square yard.

Gravel from the river Elbe, 1.50 marks per cubic metre, equal to 1.15 marks per cubic yard.

Pit gravel (mine gravel), 1.50 marks per cubic metre, equal to 1.15 marks per cubic yard.

Sand, 0.80 mark per cubic metre, equal to 0.61 mark per cubic yard.

Extra solid and weatherproof coarse quarry stones used for "packing layer," 1.50 marks per cubic metre, equal to 1.15 marks per cubic yard.

Coarse broken stones (same quality as above), not exceeding 8 centimetres in size, 2.00 marks per cubic metre, equal to 1.53 marks per cubic yard.

Small broken stones (same stone as above), not exceeding 5 centimetres in size, 3 marks per cubic metre, equal to 2.30 marks per cubic yard.

Small broken basalt stones (not exceeding 4 centimetres in size), from Tischlowitz quarries, 3.50 marks per cubic metre, equal to 2.65 marks per cubic yard.

Small broken basalt stones (not exceeding 4 centimeters in size), from Praskowitz quarries, 4.15 marks per cubic metre, equal to 3.17 marks per cubic yard.

Small broken pieces of porphyry, 1.60 marks per cubic metre, equal to 1.22 marks per cubic yard.

Small broken pieces of "grünstein" (greenstone), 3.00 marks per cubic metre, equal to 2.30 marks per cubic yard.

Finely broken "greenstone," 3.50 marks per cubic metre, equal to 2.65 marks per cubic yard.

Asphalt powder, 7.70 marks per 100 kilograms.

Dressed paving stones from the quartz porphyry quarries near Brussels, Belgium, measure being taken upon the completed pavement, free delivery to the place of construction. First class, 4.50 marks per square metre, equal to 3.75 marks per square yard; second class, 3.50 marks per square metre, equal to 2.92 marks per square yard.

MATERIAL USED FOR ROAD BUILDING AND STREET PAVING.

The kinds of stones universally used for building roads and paving streets are the following: Dressed paving stones of "grünstein" (greenstone), specific weight, 3.2; quartz-porphyry, syenite, granite, specific weight 2.8; rough irregular paving stones of granite and syenite, shaped at the quarries before they are made use of; artificial paving stones cast from copper slags; small, broken pieces of basalt, of syenite, and of "greenstone;" beaten asphalt is obtained from Val de France, Seysel, and Sicily. It is delivered pulverized and ready for use.

The dressed paving stones are divided according to their size into three classes.

Of first-class stones about 27 will form 1 square yard (32 to 1 square metre). They must measure 0.185 to 0.21 yard (17 to 19 centimetres) in height, and 0.155 to 0.185 yard (14 to 17 centimetres) in width.

Of second-class stones about 33 will form 1 square yard (39 to 1 square metre). Height required, 0.165 to 0.185 yard (15 to 17 centimetres); width required, 0.130 to 0.165 yard (12 to 15 centimetres).

Of third-class stones about 42 will form 1 square yard (50 to 1 square metre). Height required, 0.14 to 0.165 yard (13 to 15 centimetres); width required, 0.11 to 0.14 yard (10 to 13 centimetres).

The length of the stones of all three classes is proportionate to their width as 5 to 3.

The top of the stone must be even and have sharp, regular edges. Their shape must be like a truncated pyramid, and should resemble as much as possible a prism. The incline of the sides must not exceed one-tenth of the height.

Natural stones hewn into exact cubic shape are not used, this process being too expensive; but paving stones cast from copper slags are delivered and used in that shape.

During the year 1890 the demand for good paving stones was so great that they had to be purchased in large quantities from the quartz porphyry quarries near Brussels, in Belgium. The stones purchased from these quarries are of two (first and second) classes, and prices

have been stated above. Experience will show whether it be profitable to use these stones for other purposes or not.

CONSTRUCTION AND REPAIR OF STREETS.

Macadamized streets.—Every macadamized street must, according to the law, consist of a rock substructure and a rock superstructure. The substructure supports the superstructure and prevents it from sinking into the ground. The superstructure forms the wearing surface of the street and protects the roadbed against dampness with its injurious effects. Whenever a street or carriage road is constructed, the soil on which the rock substructure is to be placed is, after necessary drainage, thoroughly soaked with water and then rolled tight with a street-roller, which is either drawn by horses or propelled by steam power, until the surface becomes completely smooth.

The substructure consists either of a layer of coarse broken stone (the single stone not exceeding 0.09 yard [=8 centimetres] in size), see Fig. 1, or of a row of large stones, so-called "packing layer," see Fig. 2.

Fig. 1.

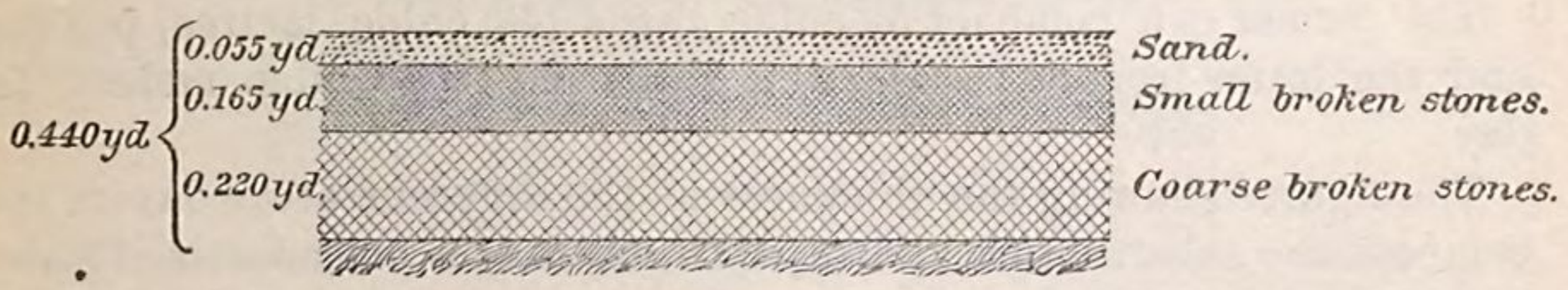
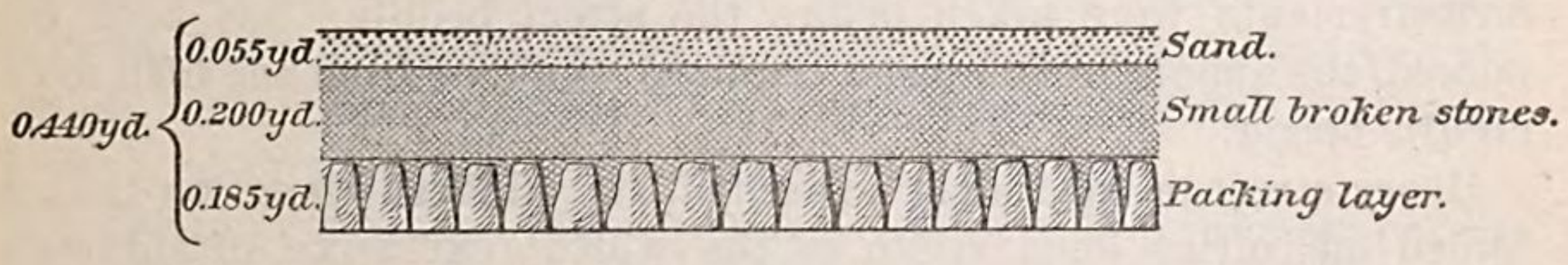


Fig. 2.



The substructure of coarse broken stone is used in such cases when the soil or foundation is found to be soft and not resistant. This layer must be at least 20 centimetres thick and is but slightly rolled before placing on the superstructure. (Fig. 1.)

If the natural foundation is solid the substructure generally consists of large quarry stones, not exceeding 0.19 yard (17 centimetres in height. (Fig. 2.)

These stones form the so-called "packing layer," and are carefully placed by hand on the smoothed and graded roadbed in close rows with their broadest side downwards and their points turned upwards to prevent their working loose. The spaces between these stones are filled out with smaller stones and the projecting tops, if any, knocked off. (Fig. 2.)

In both cases a layer of small broken stone is spread on the substructure. thus forming the superstructure.

With reference to Fig. 1 this superstructure must be at least 0.16 yard (15 centimetres) thick to Fig. 2 at least 0.2 yard (18 centimetres) thick.

Before spreading, these small stones must be passed through a screen, so as to free them from all dust and earth; their size must not exceed 0.055 yard (5 centimetres) and not be smaller than 0.044 yard (4 centimetres), according to the firmness of the rock used.

It must not be omitted to state that this superstructure of small broken stone consists of two separate layers, each layer being separately rolled tight, while soaked with water, thus increasing its firmness. When the desired road profile is obtained and the stones lie closely and firmly together, the dust, earth, and gravel left from the screening of the stones is spread over the surface.

The roller is then again passed over, and the road is completed with a layer (about 0.055 yards thick) of moist, binding gravel sand.

It may be well to add here that the rollers used for crushing the surface of the roads or streets, called "compression rollers," are either drawn by horses and weigh about 6,000 kilograms, or propelled by steam power and weigh from 10,000 to 15,000 kilograms.

The former can compact 52 cubic yards (40 cubic metres) per day, and the latter from 80 to 100 cubic yards (60 to 80 cubic meters) per day.

The figures showing the thickness of the different stone layers that compose the substructure and superstructure of a macadamized street, as indicated in red ink on the above diagrams, are understood when the street or road is completed and ready for public use; if, however, such measurements were taken before the street bedding has been compacted, the quantity of material required would be from one fifth to one-eighth larger.

Every street or road must be arched, the highest elevation thus obtained measuring one-sixtieth of the width (exclusive of sidewalks) for macadamaized streets, one eightieth for paved streets, and one one-hundred-and-twentieth for asphalt streets. (Figs. 1, 2, 3.)

The curbstones of the sidewalks are located from 0.11 to 0.13 yards (10 to 12 centimetres), above the street surface; the sectional inclination of the sidewalks being fixed at one-thirty-third, their width being under normal conditions one-fifth of the entire width of the street, three-fifths, therefore, remaining for the carriage road. (See Figs. 1, 2, and 3).

City streets are generally wider than country roads.

The width of state roads varies between 6.6 and 10.9 yards (6 and 10 metres), and the width of country ("communication") roads must be at least 5.5 yards (5 metres) in open country and 7.7 yards (7 metres) within villages or towns. In Dresden all new streets must measure at least 14.2 yards (13 metres), increased to 34.9 yards (32 metres) and more, if necessary. It may be stated that the average width is figured

at 21.8 yards (20 metres). Based upon the above-mentioned widths, the proportion of the sidewalks to the main carriage road of one-fifth to three-fifths is maintained.

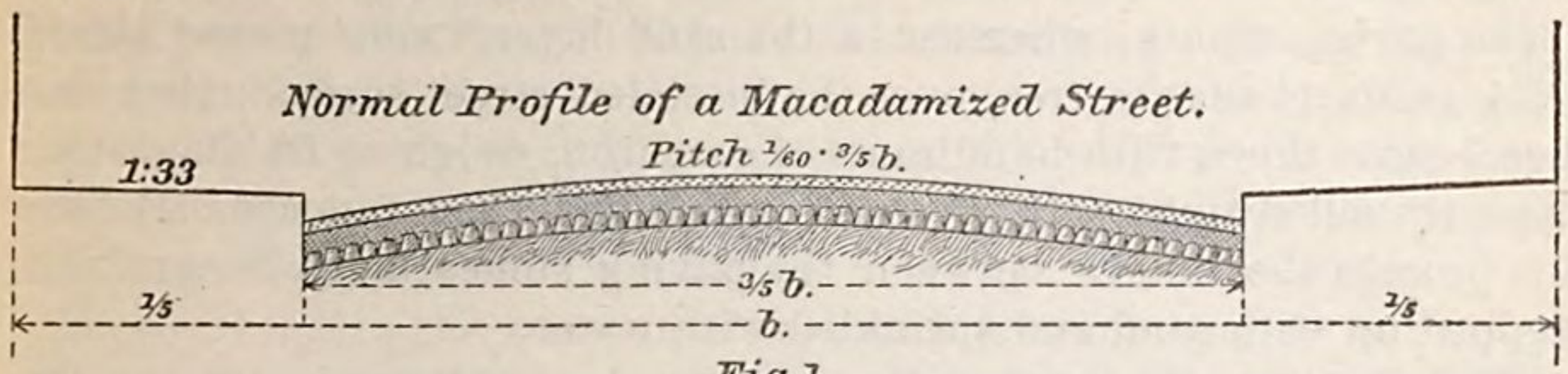


Fig. 1.

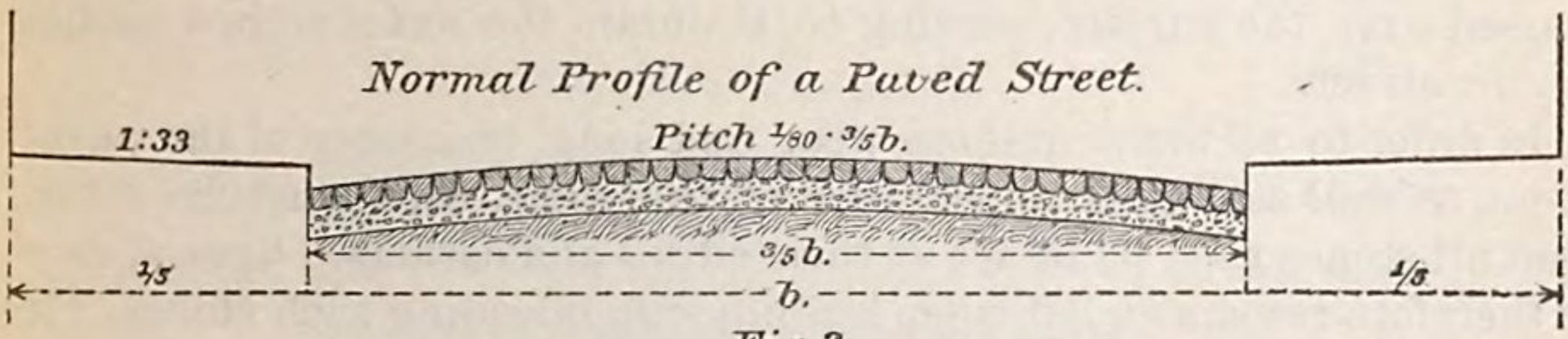


Fig. 2.

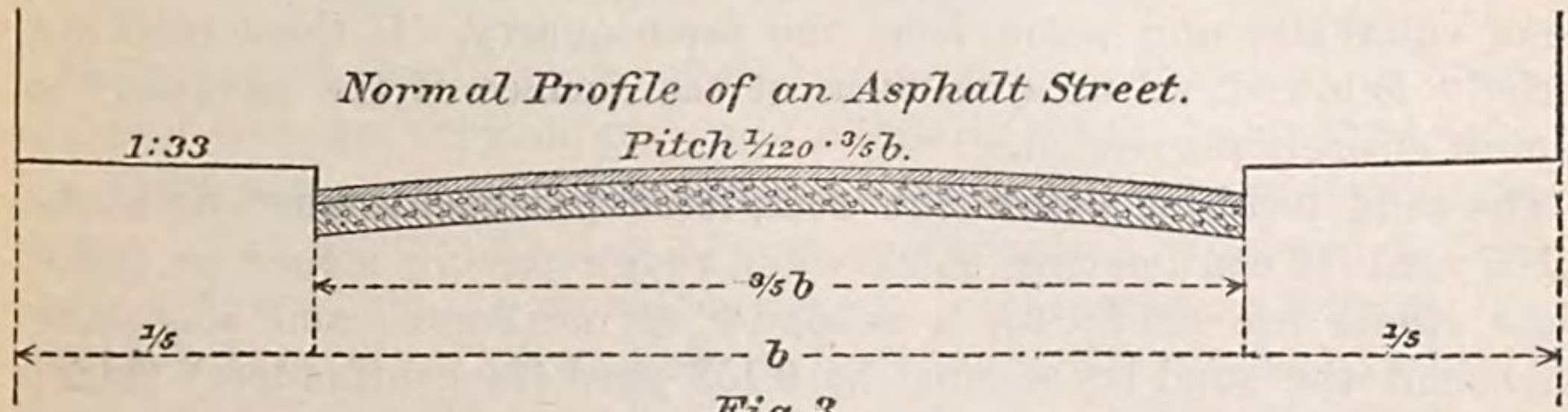


Fig. 3.

Should any division different from the above be decided upon it is always in favor of the sidewalks, according to the local requirements. It occurs, for instance, that very broad streets are provided with a central elevated promenade reserved for pedestrians only.

In order to prevent the rain-water from stagnating on the side of the street and to conduct it into the sewer openings the street must have below the curbstones a longitudinal incline of at least 1 to 250 alternately in both directions; the minimum for this incline is 1 to 300.

PAVED STREETS.

As above mentioned almost all city streets in Saxony are paved. The bedding on which the paving stones are placed consists in all cases of gravel sand, called paving sand (from the Elbe). This bedding of paving sand is placed immediately on the natural soil when the latter offers a good and solid foundation (Fig. A). If, however, the street bed is artificial, therefore less resistant, the foundation is strengthened by a layer of coarse quarry stone, upon which the paving sand is then spread (Fig. B). Streets are frequently temporarily paved with coarse quarry stones, which, however, must be cut to fit without leaving too large cracks. These stones are cut into paving stones averaging from 0.18 by 0.2 yards (16 by 19 centimetres) in size. Their broad-

est surface must be plain, but their shape need not be regular; their width should be about 0.13 by 0.19 yards (12 by 17 centimetres), the incline of their sides not exceeding 1 to 5.

The paving stones, when set in the sand layer,* must project about 00.44 yards (4 centimetres) over the intended street surface; they are then beaten down with hand rams of cast iron, weighing 50 kilograms, or partly rolled tight with a steam roller and then rammed. Before this process the cracks between the paving stones must be carefully stopped up with sand and sprinkled with water.

While setting the paving stones a wooden pattern is continually passed over the surface, serving to maintain the exact arched profile of the street.

In order to secure a uniform wear and long resistance of the pavement, as well as a good appearance of the same, care must be taken that all stones used be intact at their edges and corners. Special care is therefore recommended when loading and unloading such stones. It is further recommended that on one tract of pavement the stones should be of equal size and come from the same quarry. If these rules are strictly followed, an unequal wear of the surface of the pavement is almost entirely prevented.

The sand bedding below the completed pavement must be about 0.175 yard (16 centimetres) thick when rough paving stones or third-class stones are used; for a second-class pavement and slag-stone pavement the sand layer must be 0.153 yard (14 centimetres) thick; for a first-class pavement, 0.13 yard (12 centimetres) thick.

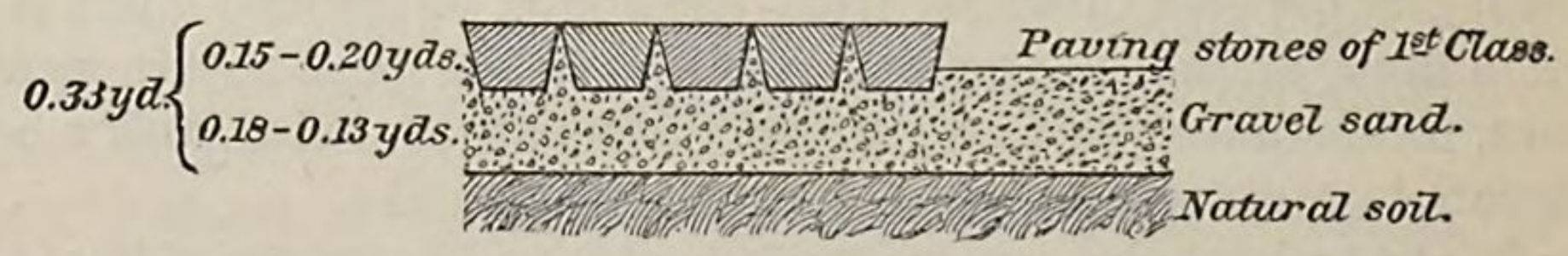


Fig. A.

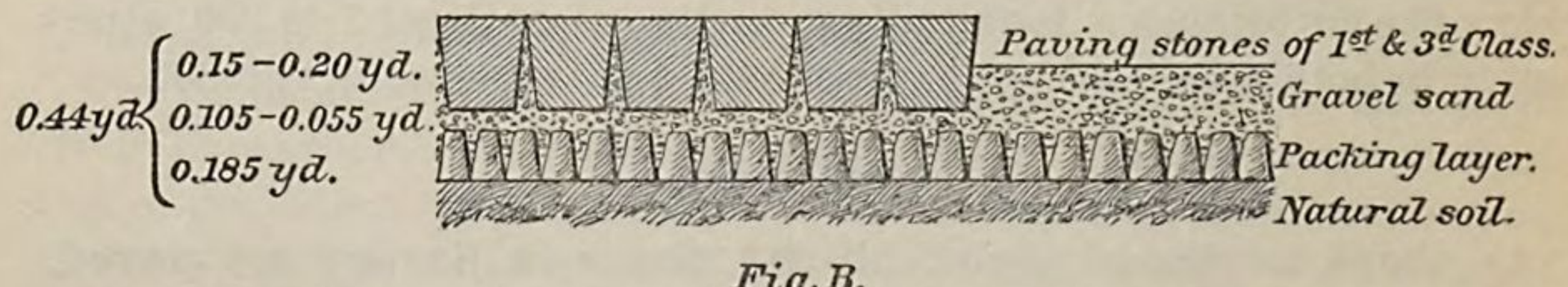


Fig. B.

First-class paving stones are only used in the most fashionable parts of the city, or for such streets on which the traffic is very heavy; third-class stones, for less important streets and centers of squares; second-class stones, for all other streets and for pavement between street-car rails.

Streets which are newly laid out are at first macadamized, and only provided with a regular stone pavement after houses have been erected on the same. For this reason the original macadamized surface is laid out at a height to serve as foundation to the projected pavement.

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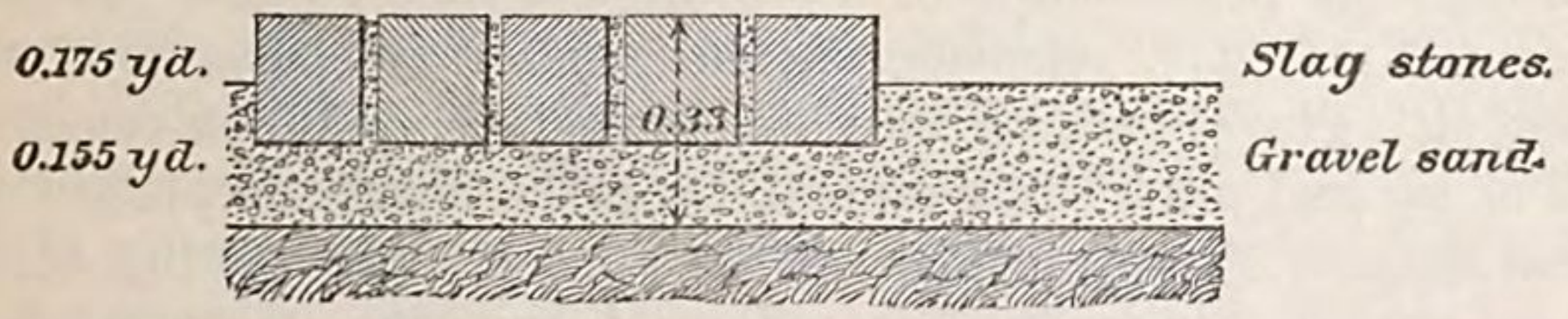
* This layer is 0.22 by 0.26 yards (20 by 24 centimetres) thick.

A new kind of paving material—cast slag stones—has been invented during the last 10 years. These slag paving stones are exact cubes, measuring 0.175 yard (16 centimetres) in diameter, and are very solid. Such a pavement is claimed to have an extraordinary resisting capacity and is regular and smooth. Hardly any noise is caused by carriages, etc., on streets paved with slag stones, and it is very easy to keep them clean; slag stones are, therefore, frequently used for sidewalk crossings, and for gutters on macadamized streets.

There are, up to the present date, but few streets paved with slag stones in Dresden, because its durability has as yet not been sufficiently tested.

Slag Stone Pavement.



The principal disadvantage of slag-stone pavement is that in course of time it becomes very slippery and offers little hold to horses' hoofs.

Asphalt pavement.—Asphalt is used most extensively for paving streets. The quality used is almost exclusively compressed asphalt. The layer on which the asphalt is spread is prepared as follows: The ground is at first carefully rolled, its level being held at 0.27 yards (25 centimetres) below the projected street surface. On this is spread out a layer of cement concrete, composed of one part of Portland cement, four parts of gravel from the Elbe, and six parts of small broken stones. This layer, when fresh, must be 0.27 yards (25 centimetres) thick; it is then compressed to 0.216 (20 centimetres).

The cement layer must be given sufficient time to thoroughly harden. The hot asphalt is then spread over the cement; the asphalt layer, being at first 0.076 yards (7 centimetres) thick, is rolled down to 0.055 yards (5 centimetres).

The kind of asphalt in principal use comes from Val de France, or Seyssel, and is mixed with Sicilian asphalt in the proportion of 1 to 3.

Asphalt Pavement.

Wood pavement.—In the year 1877 several streets were paved with wood. This wood pavement consisted of paving blocks of pine wood 0.11 yard (10 centimetres) in size. The foundation must be a layer of

concrete 0.216 yard (20 centimetres) thick. The cost of such pavement proved to be 13.80 marks per square yard (17 marks per square metre).* The wood, however, did not offer sufficient resistance, and was replaced by asphalt 6 years later.

In 1887 another attempt was made with oak paving blocks set on a layer of concrete of 0.216 yard (20 centimetres), but the cost of such pavement amounting to 17.14 marks per square yard (20.50 marks per square metre)*—the very cheapest oak costing 15 marks per square yard (18 marks per square metre)—this system was abandoned.

Very recently extensive attempts have been made with beech wood. The single blocks were fastened together with wire, thus forming larger blocks, and were used for paving a temporary street-car line running through the promenades of a projected "ringst vasse" (circular street around the city). Considering the temporary character of this construction, a gravel bedding only was placed below the pavement, a mixture of tar and pitch being poured over the former to protect the pavement against the penetration of dampness. The paving blocks were then set and the cracks filled out with the same mixture of tar and pitch. It has, as yet, been impossible to form an opinion of the durability of this kind of pavement, as it has only been in use for a year.

COST OF STREET CONSTRUCTION.

The cost of constructing the different kinds of streets, as described above, exclusive of the costs of transportation of building material to Dresden, but inclusive of the expenditures for short local transportation within the city were figured during the past year as follows:

Macadamized street having one layer of small broken stone, 0.164 yard thick, and one layer of coarse broken stone 0.219 yard thick, when using finely broken syenite, 3.30 marks per square metre (2.75 marks per square yard); when using Tischlowitz basalt, 3.40 marks per square metre (2.84 marks per square yard); when using Praskowitz basalt, 3.45 marks per square metre (2.88 marks per square yard); when using porphyry, 3.05 marks per square metre (2.55 marks per square yard); when using greenstone, 3.40 marks per square metre (2.84 marks per square yard).

Macadamized street, having one layer of small broken stone, 0.196 yard thick, and one layer of large quarry stones (packing layer) 0.187 yard thick, when using finely broken syenite, 3.15 marks per square metre (2.63 marks per square yard); when using Tischlowitz basalt, 3.30 marks per square metre (2.76 marks per square yard); when using Praskowitz basalt, 3.45 marks per square metre (2.88 marks per square yard); when using porphyry, 2.95 marks per square metre (3.30 marks per square yard); when using greenstone, 3.40 marks per square metre (2.84 marks per square yard).

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* The prices for the different kinds of wood pavement include wages, material, etc.

Rough pavement on layer of gravel, 4.80 marks per square metre (4.40 marks per square yard).

Dressed (regular) pavement on layer of gravel, using first-class stones, porphyry, granite, and syenite, 9.60 marks per square metre (8 marks per square yard); greenstone, 10.80 marks per square metre (9 marks per square yard). Using second-class stones, porphyry, granite, and syenite, 9.20 marks per square metre (7.70 marks per square yard); greenstone, 10.80 marks per square metre (9 marks per square yard). Using third-class stones, porphyry, granite, and syenite, 8.20 marks per square metre (6.85 marks per square yard); greenstone, 10.80 marks per square metre (9 marks per square yard).

Slag stone pavement on layer of gravel, 6.40 marks per square metre (5.35 marks per square yard).

Dressed (regular) pavement on layer of large quarry stones (packing layer). Using first-class stones, porphyry, granite, and syenite, 10.60 marks per square metre (8.87 marks per square yard); greenstone, 11.80 marks per square metre (9.87 marks per square yard). Using second-class stones, porphyry, granite, and syenite, 10.15 marks per square metre (8.50 marks per square yard); greenstone, 11.80 marks per square metre (9.87 marks per square yard). Using third-class stones, porphyry, granite, and syenite, 9.20 marks per square metre (7.68 marks per square yard); greenstone, 11.80 marks per square metre (9.87 marks per square yard).

Slag stone pavement on layer of coarse quarry stones ("packing layer"), 7 marks per square metre (5.85 marks per square yard).

Asphalt pavement, composed of 0.220 yard (20 centimetres) of concrete, 3.60 marks per square yard (4.30 marks per square metre); 0.053 yard (5 centimetres) of asphalt, 10.60 marks per square yard (12.65 marks per square metre); giving a total of 14.20 marks per square yard (16.95 marks per square metre).

These prices for asphalt pavement were paid to private building companies, who undertook the first construction of asphalt streets in Dresden, giving guaranty for 5 years.

All asphalt pavement is now executed by the government building department and not by private contractors, naturally without guaranty. The costs therefor being reduced by 3.50 marks per square yard (4.20 marks per square metre), thereby giving a total cost of 10.70 marks per square yard (12.75 marks per square metre) for asphalt pavement as above described. It must be further understood that the quotations given for asphalt pavement include all costs of transportation, as it has been impossible to ascertain such costs, delivery being free Dresden.

The preparation and profiling of the natural foundation (substructure) of all street constructions amounts to 0.84 mark per square yard (1 mark per square metre) in average, and is not included in any of the foregoing figures.

In the city of Leipzig, where the paving of the streets is mostly intrusted to private contractors, the costs for the different kinds of pavement during the past year were figured as follows:

Slag stone pavement, 6.20 marks per square yard (7.40 marks per square metre).

Dressed (regular) pavement, first-class stones, 9.13 marks per square yard (10.90 marks per square metre); second-class stones, 8.48 marks per square yard (10.15 marks per square metre); third-class stones, 8.23 marks per square yard (9.85 marks per square metre).

Asphalt pavement, thickness of layers as described above, 13.88 marks per square yard (16.60 marks per square metre).

It will be noted that the costs for paving in Leipzig do not differ very much from those in Dresden. Only slag stone pavement is much less expensive, because the rates for transportation are much lower to Leipzig than to Dresden.

During the year 1889 the "Tieflauamt" (board of substructures) of Dresden showed the following figures:

Kind.	Square yards.	Square metres.
Macadamized streets	6,600	5,500
Dressed (regular) pavement	62,500	52,300
Rough (irregular) pavement	32,400	27,000
Asphalt pavement	7,500	6,300

Seven thousand four hundred and eighty yards (6,850 metres) of sewer, of a medium oval-shaped section measuring 60 centimetres in height and 40 centimetres in width, and 45,600 square yards (38,200 square metres) of sidewalks, constructed partly for public and partly for private use. The total expenditure incurred by the Tiefbauamt during the year 1889 for the above constructions amounted in a round sum to 1,115,000 marks. Since the close of 1889 the cost of material and for wages has considerably increased.

CONSTRUCTION OF SIDEWALKS.

Most of the sidewalks are covered with granite slabs 0.164 yard (15 centimetres) thick, and cost, according to the quality of the stone, from 9.20 marks per square yard (11 marks per square metre) to 10.86 marks per square yard (13 marks per square metre). The cost of laying the slabs, inclusive of expenses for sand and cement (used to fill out the space between each slab) are figured at 92 pfennings per square yard 1.10 marks per square metre). Exceptionally wide sidewalks are paved with a single line of granite slabs, and on each side a "mosaic" pavement composed of small stones is laid.

These "mosaic" stones consist of limestone or of porphyry; they are cubic-shaped, and do not exceed 9 centimetres in size. This pavement costs 3.90 marks per square yards (4.68 marks per square metre).

It is less frequent that the described portions of wide sidewalks are covered with a layer of cement. In such cases the cement layer must be 0.022 yard (2 centimetres) thick and rests on a foundation of concrete 0.145 yard (13 centimetres) thick. Cement slabs 0.065 yard (6 centimetres) thick and 0.38 yards in diameter, resting on a foundation of mortar 0.022 yards (2 centimetres) thick, are also used for sidewalks. Both systems of construction cost 3.90 marks per square yard (4.68 marks per square metre).

An altogether exceptional mode of paving sidewalks consists in the use of ribbed square plates of "Dutch tile" from Meissen, 0.065 yard thick by 0.38 yard in diameter. The foundation consists of a layer of cement, mortar or concrete 0.153 yard thick. The average cost is 6.10 marks per square yard (7.32 marks per square metre.)

The curbstones for sidewalks are mostly of dressed granite. The cost for curbstones, including laying, wages, etc., are: When 0.44 yard wide and 0.22 yard high, 7.90 marks per yard (8.60 marks per metre); when 0.22 yard high and wide, 5.30 marks per yard (5.80 marks per metre).

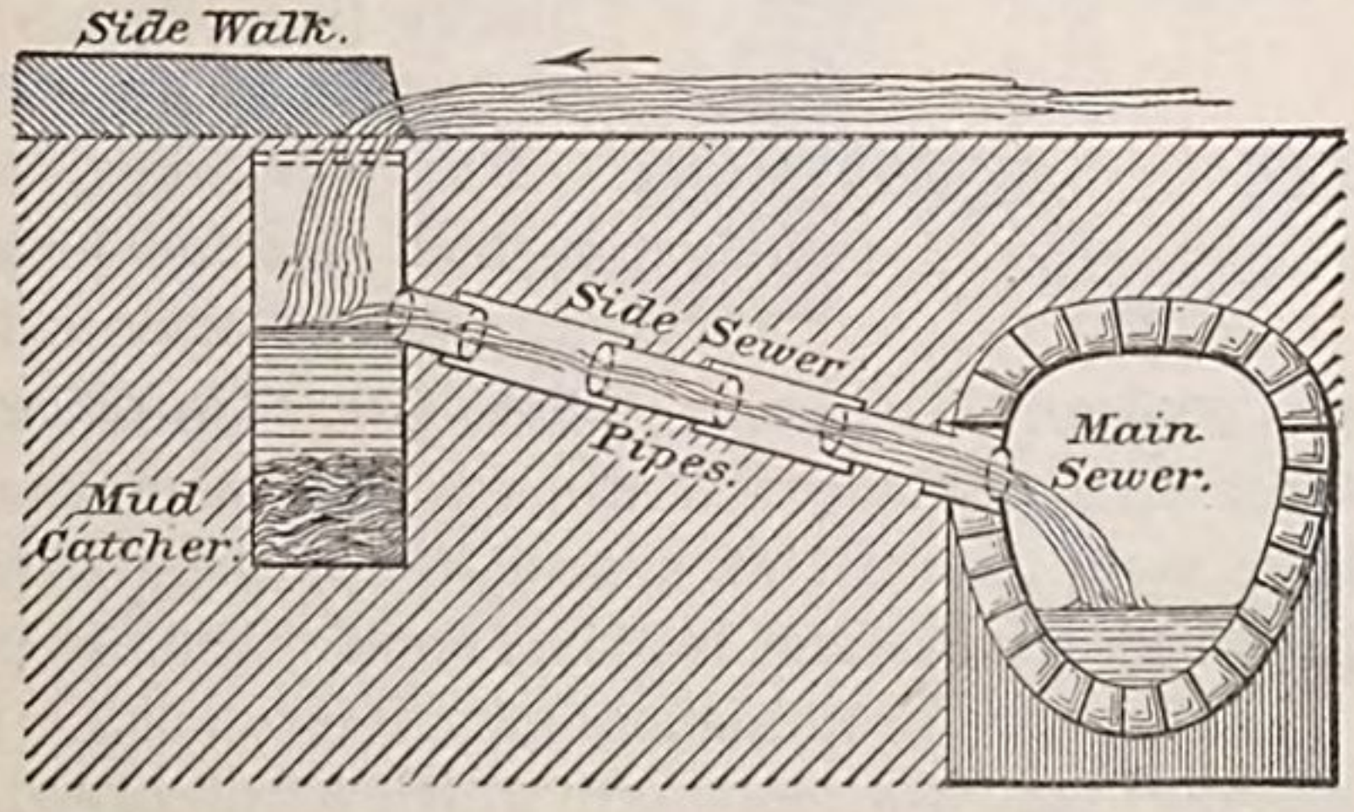
Slag curbstones are also, but not frequently, used, and cost when 0.165 yard wide and 0.22 yard high, 1.38 marks per yard (1.50 marks per metre).

SEWERS.

Every city street must be provided with a means of sewerage and drainage; new streets, when constructed, and before houses are built on the same, must be provided in the same way. These drainages consist of a main sewer located in the center of the street.

Side sewers, 0.165 to 0.22 yard (15 to 20 centimetres) in diameter, serve to conduct the water from the street into the main sewer. These side sewers are made of earthen pipes, and are located 32.7 yards (33 metres) from each other. The sewer openings, serving to lead off the rain water from the surface of the street, are located in the street gutter or form part of the granite curbstone. When located in the street gutter these apertures consist of square iron boxes.

To prevent the mud and dirt from obstructing or stopping up the



sewer pipes, a "mud-catcher" of brickwork, or of iron, is fixed below each aperture, and is 1.10 yards deep by 0.44 yard wide.

Side sewer pipes of same size as above also serve to conduct the rain water from the roofs, as well as the waste water from the houses into the main sewer.

In narrow streets the central sewers are in most cases too small to permit men to pass through for cleaning and repairing purposes. Such sewers are then provided with round vertical manholes, located at an average distance of 32.7 yards from each other, and serve for cleaning as well as draining purposes. These manholes are covered with iron lids, which are coated with asphalt or plated with oak, on asphalt streets, to prevent noise.

Formerly the sewers were constructed of sandstone masonry, cemented with mortar; smaller sewers were constructed of sandstone blocks hollowed out in shape of gutters, and either covered with stone slabs (Fig. 1) or arched (Fig. 2).

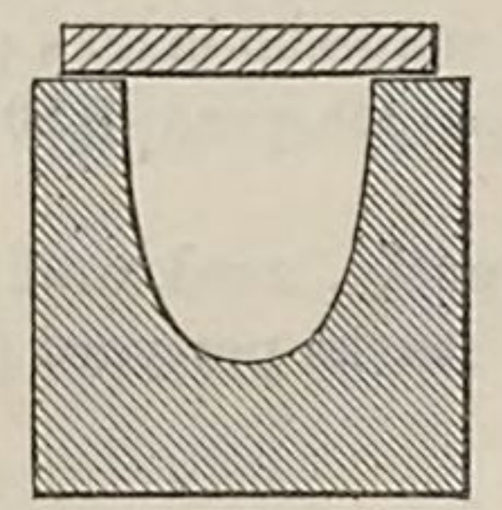


Fig. 1.

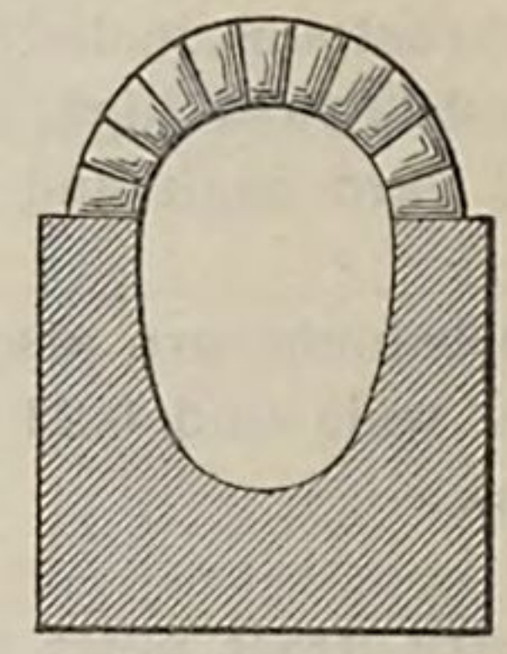


Fig. 2.

At present sewers are universally constructed of cement, mortar, and concrete; sewers of smaller diameter (varying from 0.49 yard in height and 0.33 yard [0.3 metre] in width, to 1.64 yard [1.5 metres] in height, and 1.1 yards [1 metre] in width) are furnished ready for use in one or two pieces of 1 metre (1.1 yards) in length.

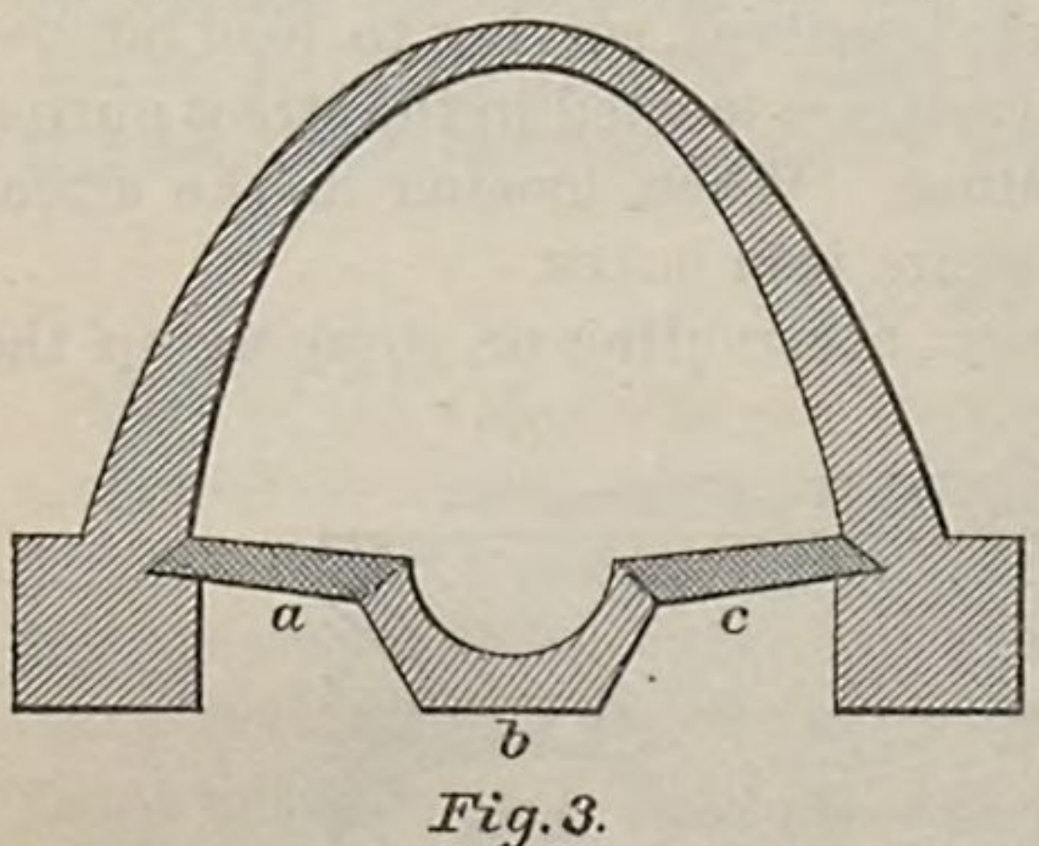


Fig. 3.

Larger sewers of a profile, as shown on the annexed diagram, have a gutter for waste water, and are constructed of stamped concrete, some parts of the foundation blocks (as *a*, *b*, and *c*) being furnished ready shaped for use.

The manholes, as above described, are at present also constructed of stamped concrete, and not of brickwork as heretofore.

The width of the sewers is based upon the following calculation:

$$V = F\sqrt{\frac{\frac{F}{S} \cdot \frac{h}{l}}{0.00015 + \frac{0.0000045.S}{F}}}$$

V = The quantity of water in cubic meters required to be drained per second.
F = The cross section of the sewer in square metres.
S = The interior circumference of the sewer in metres.
$\frac{h}{l}$ = The relative (actual) incline of the sewer.

The quantity of water to be drained per second from 1 hectare (10936 square yards of area) is assumed to be as per following table:

Description.	Rain water.	Waste water.	Total.
	Cub.met.	*Cub.met.*	*Cub.met.*
Densely built	0.05	0.0034	0.0534
Less densely built	.04	.0023	.0423
Single houses (residences)	.03	.0004	.0304

The above figures refer to the minimum profile or section of a sewer. All calculations are strictly based upon these figures, even if circumstances rendered a smaller sewer practicable. A rainfall as heavy as 0.02 yard (18 millimetres) per hour, is provided for in the above calculations.

The cost of sewers at a depth of 2 metres, during the past year, was as follows:

Size of sewer.		Cost of constructing the sewer channel	Digging and filling up.	Total in marks.	Per 1.1 yard. 1 metre for increased depth of sewer.
Height.	Width.				
Yards.	*Yards.*	*M. pf.*	*M. pf.*	*M. pf.*	*M. pf.*
0.491	0.327	7 40	8 41	15 81	2 65
0.573	0.382	9 23	8 88	18 11	2 83
0.654	0.436	11 40	9 30	20 70	3 10
0.817	0.545	14 40	10 30	24 70	3 33
0.982	0.654	21 15	11 70	32 85	3 61
1.146	0.764	27 65	14 25	41 90	4 47
1.314	0.872	33 90	15 40	49 30	4 75
1.635	1.09	43 75	18 25	62 00	5 40

The cost of a manhole connecting a sewer with the street surface, when the sewer is located at a depth of 2.5 metres, is 105 marks; adding 8 marks for extra work and 37 marks for iron lid, gives a total of 150 marks, in a round sum. Each metre of increased depth 37 marks more. An oak plated lid costs 53 marks instead of 37 marks. The side sewer pipes, when 0.165 to 0.22 yard in diameter, cost, ready-made, including laying and fastening, from 3.10 to 4.02 marks per yard.

Brick mud-catchers provided with iron apertures cost 32.30 marks apiece; solid stone mud-catchers, 35.30 marks apiece, inclusive of all work connected; granite apertures with stone lid cost 44 marks.

APPORTIONMENT OF COSTS—STREET CONSTRUCTION AND REPAIR.

All expenses caused by a reconstruction or total repair of an existing street are paid by the city treasury. New streets, however, are laid out at the cost of the proprietors of the adjacent grounds or houses. To cover the expenses for sewerage such proprietors are required to pay 21 marks per yard (23 marks per metre) of front extension of their premises. For corner grounds the actual length of premises must be increased by the average width of the two adjacent streets.

The costs of primary construction of streets, such as earthworks sewerage, macadamizing, gravel footpaths, in some cases rough pavement, must be borne by the proprietors of adjacent houses or grounds in proportion to the extension of their premises. Street crossings are constructed at the cost of the proprietors of the four corner buildings, These expenses are eventually advanced by the contractors to the landed proprietors, who, temporarily, may not be desirous to pay their share at once, under the condition, however, that such outlays of money be refunded by the proprietors when houses are erected on their premises.

In case such primary construction of a street proves to be a public necessity, therefore, not originating from an application of private persons, the costs must be borne by the city treasury. The money thus expended can, however, later on, be claimed from the landed proprietors, as soon as they begin to build on such streets.

The construction of streets (called "blind alleys") without any communication with other streets is prohibited.

The construction of new streets is only permitted upon submission of plans that must be approved of by the "tiefbauamt" (board of substructures), which then undertakes the building.

It was formerly the duty of the house proprietors to clean street and sidewalk; this is now all done by the city, but to defray the expenses the sum of 2.00 marks per square metre (1.67 marks per square yard) is collected from the house proprietors when the area is ceded to the city for street construction purposes.

The street-car companies are at the present time required to pay the city for cleaning the pavement between their rails, as well as 0.65 yard= 0.6 metre width of pavement outside the rails, at the rate of 8.4 pfennigs per yard (10 pfennigs per metre.) For squares and streets with only one row of houses, as for instance along the river, the proportionate division of the sums collected from the house proprietors to cover the expense of construction and sewerage varies, according to local regulations, between the above mentioned figures and twice as much.

The decision of the "Rath" (city council) is required whenever it appears urgent to pave a macadamized street.

The first pavement, if rough, is also executed at the cost of the adjacent proprietors, and this according to the regulations above mentioned.

If the first pavement consists of dressed, regular, paving stones instead of rough, the surplus expenses as well as all further costs for repair and maintaining, must be borne by the city treasury.

It is considered exceptional when the adjacents desire a superior pavement on their street than the city authorities deem necessary for the local requirements. If such applications are approved of the applicants are held to bear the surplus costs, or to pay a certain sum upon other mutual agreement.

All repairs of streets, when completed, must be undertaken by the city.

Macadamized streets are usually transferred 3 months after they have been opened to the public, for maintenance to the city, so that the parties that originally built the streets are compelled to bear the expense of maintenance during fully 3 months. The reason for this is that a new macadamized street requires unusual attention and care during the first period of its existence. The street-car companies are also held to bear part of the costs for constructing and keeping the streets. The portion of the street constructed and maintained at the cost of these companies consists of the substructure below the rails and the portion between the rails extending to 0.65 yard (0.6 metre) beyond both outside rails.

All sums expended by the city treasury for repair and construction of streets must be approved of by both the "Rath" and the "Stadt verordneten"; on the whole the construction of streets is undertaken upon the petition of those held by law to bear the expenses, the estimated cost being paid by these parties to the city treasury.

The costs for new sidewalks, or for alterations of the same (that may appear necessary through the erection of new buildings) must be borne by the adjacents.

Should the costs for sidewalks exceed the standard estimates the surplus expenditure is borne by the city.

Costs resulting from maintenance or reconstruction of a sidewalk, occurring in case of an alteration in the direction of the street and expenses for widening the same by reason of an increase of traffic, are paid by the city treasury.

Towards the end of the year 1889 the city of Dresden, counting 276,000 inhabitants, possessed within its limits 1,160,000 square yards (970,000 square metres) of paved streets, of which 520,000 square yards (434,000 square metres) were paved with dressed stones, the remaining with rough stones; further, 840,000 square yards (700,000 square metres) of macadamized streets. The maintenance and repair of paved streets caused an expenditure of 46,000 marks during the year 1889, or 4 pfennig per square yard (4.74 pfennigs per square metre). The main-

tenance of the macadamized streets cost in 1889 150,000 marks, or 17.9 pfennig per square yard (21.4 pfennig per square metre).

It should be stated that the above figure for maintaining the macadamized streets includes the maintaining of the gravel sidewalks. An approximate calculation shows that the maintaining of that part of a macadamized street used only by carriages would average 15 pfennig per square yard (18 pfennig per square metre).

Excluded from the above figures is that portion of the streets constructed and maintained by the street-car companies, covering an area of 826,000 square metres (985,000 square yards) of paved surface, and 100,000 square metres (120,000 square yards) of macadamized surface.

The maintenance of the asphalt streets covering an area of 19,000 square metres (22,700 square yards) did not cause any notable expense for the reason that the first asphalt streets had not been constructed by the city, but had been executed by private contractors the latter still having charge of their maintenance.

In addition to this the repair of the sewers in the city of Dresden cost during the year 1889 12,000 marks; their cleaning 25,000 marks; the maintenance of sidewalks and footpaths 3,000 marks; the maintenance of the "Bauhof" (large storage grounds for street material) 2,000 marks, and the repair and renewal of apparatus and tools for street construction purposes 38,000 marks.

At the close of the year 1886 the city of Leipzig, counting 170,000 inhabitants had 486,000 square yards (406,000 square metres) of dressed pavement, 60,000 square yards (50,000 square metres) slag pavement, 360,000 square yards (301,000 square metres) rough pavement, and 14,400 square yards (12,000 square metres) asphalt pavement. The cost of repair and maintenance for these streets was figured during 1886 at 2 pfennig per square yard (2.4 pfennig per square metre) for dressed pavement and 3 pfennig per square yard (3.6 pfennig per square metre) for rough pavement.

In 1883 the expenditure for maintenance amounted to 6.3 pfennig per square metre (5.3 pfennig per square yard), no distinction being observed between dressed and rough pavement. It may therefore be stated that the average expenditure in Leipzig was equal to that in Dresden.

ADMINISTRATION OF STREETS.

The administration and gen eral management of all matters concerning the construction, repair, and maintenance of city streets in Dresden is intrusted to the "Stadt bauamt (city building board), and "Tiefbauamt" (board for substructures). The "Baupolizeiamt" (building police board) has charge of the preparation and drawing of the plans and diagrams, and also of the general regulations for construction with the coöperation of the "Tiefbauamt;" it is further the duty of the "Baupolizeiamt" to grant permits for building and to superintend the erec tion of private houses.

The duties of the "Stadtbauamt" are the following:

(1) To regulate and settle all legal and financial matters arising with the construction of new streets and their alterations (to an extent not to interfere with the duties of the "Baupolizeiamt"), until the actual construction of the street is undertaken by the "Tiefbauamt," inclusive of the expropriation. (2) To collect the shares of payment from the adjacents for street and sewer construction according to the local laws. (3) To secure guaranties for such payments, and to settle all claims that eventually may arise. (4) To direct and superintend the street police force, partly. (5) To settle all legal matters involved in the public navigable ways within the limits of Dresden, excluding, however, such that refer to the traffic on the river Elbe. (6) To keep the cash account for the city street construction. (7) To control the treasury for city street construction (separate treasury department). (8) To submit opinions upon legal inquiries made by the "Hochbauamt" (board for superstructure), and by the "Tiefbauamt." (9) To submit opinions upon inquiries relating to the publicity of a road or street. (10) To superintend and sell city property, and, on the other hand, to purchase private grounds.

The "Hochbauamt" has nothing to do with the construction of streets.

The duties of the "Tiefbauamt" are the following: (1) To plan and construct streets, sewers, and bridges in cities and towns, including the miscellaneous work, as:

(*a*) Drawing up the documents serving to raise the necessary fund; (*b*) projecting and preparing plans; (*c*) purchase of material; (*d*) insurance against sickness and accidents; (*e*) the mediation of all business transactions between private contractors with the city authorities, or submitting statements of construction and estimates of funds required for the same to the city authorities. (2) To maintain and repair the city streets, sewers, and bridges to the same extent as referred to sub No. 1, and *a* to *e*. (3) To offer technical assistance to the Stadtbauamt and to other administrative departments of the "Stadtrath" (city council), by submitting suggestions, estimates, preparation of plans, etc.

Other works that are executed in the streets, such as the laying of gas and water pipes, and of underground telegraph wires, practically belong to the respective executive departments of the "rath" or to the post-office department, but in all such cases the work and repair of the street is undertaken by the "Tiefbauamt."

The directors of the "Stadtbauamt," the "Baupolizeiamt" and the "Hochbauamt" and "Tiefbauamt" are salaried members of the "Stadtrath" (city council).

These men are academically educated as 2 lawyers, 1 architect, and 1 engineer.

The division of the "Tiefbauamt" may be of interest, as the board is

exclusively intrusted with the technical supervision of the entire street construction system.

The Tiefbauamt is, if not distinctly, practically divided into two departments, one for the interior and the other for the exterior service—preparation and execution of constructions. The first department employs, besides the office clerks, 6 technical men, among whom are 3 studied engineers.

The work in the second department is performed, according to the division of the city district, into, 3 inspections for substructures by 3 inspectors with 3 assistants, 3 substructure surveyors, and 3 substructure guards.

For maintenance of macadamized streets an extra number of 30 road-guards are employed.

The superintending force of the Bauhof (storage ground for materials and tools) with 4 officials forms a separate department, but also stands under the Tiefbauamt.

The Bauhof serves to store away all materials for road and street construction that are not transported for immediate use direct to where the street is being built, such as sand and gravel; some stone is partly prepared for use within the Bauhof. The machines, implements, and tools are also stored there, and, when necessary, repaired. The Bauhof also serves to store away old used building material, provided the same be in good condition, until further use can be made of it.

The administration of the Tiefbauamt in the city of Leipzig is organized in a similar way, with the exception that the head engineer is not a member of the "Rath." The other men employed are, 3 studied engineers and 6 technical employés, 1 street master, 1 surveyor, and 6 guards, the latter three being employed during the construction of works.

In Leipzig the duties of the administrative force are more extended, inasmuch as the "Tiefbauamt" has charge of the city survey (this being in Dresden the duty of the "Baupolizeiamt") and is required to superintend the laying of gas and waterpipes, as well as the maintenance and regulation of the water-ways, the latter being very extended.

The repair of the macadamized streets, on the contrary, belongs to an entirely different branch of the city administration.*

The annual expenditure for salaries and stationery amounts to 25,000 marks for the Stadtbauamt and 71,500 marks for the Tiefbauamt, 14,000 marks being used for the offices, 48,000 marks for the three substructure inspections, and 9,500 marks for the Bauhof (storage grounds).

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* Attention is hereby called to a publication obtainable at all booksellers, entitled: "Organisation der Behörden für die innere Verwaltung" (Organization of the Authorities for the Interior Administration) and to "Die revidirte Städteordnung vom 24. April 1873 (Revised city Regulations of April 24, 1873). These two books contain all desirable information about the organization of the city administration and its divisions.

INFLUENCE OF IMPROVED STREETS ON PROPERTY VALUES.

What influence the construction of a street has on the land value may be best judged from the time when new streets are laid out for the purposes of erecting houses along them.

The ground and the productiveness of the soil increase, under such circumstances, far over ten times in value when compared with the value of an ordinary field or meadow.

Agricultural land becomes practically city lots as soon as the decision of the city authorities to construct a street through it is known, but building can only be begun when the street is completed. The traffic with the center of a city is greatly facilitated when the means of communication consist of solidly built and well kept streets; therefore the land values and the wages for labor increase.

Good roads, as well as railroads and water-ways, form a quick and cheap means of transportation of the necessaries of life from the country to the cities, and therefore may be considered as one of the most important conditions for their prosperity.

It is far easier to keep good streets clean than bad ones.

Therefore, the sanitary condition in medium sized and large cities is greatly dependent upon the system observed in constructing and keeping the streets.

STATE AND COUNTRY ROADS.

In Saxony the highways—state roads as well as country roads—are mostly macadamized.

The surface of the more important and more used roads is strengthened with small broken stones tightly wedged in and rammed down, under which there is a layer of coarse broken stone.

The surface of less important roads is only composed of a layer of small broken stone on gravel or sand; in some cases gravel only is used.

The stones used for the construction and repair of the roads are generally obtained in the closest vicinity, and in this case the best of what can be had is chosen. For some state roads, especially those that are subject to frequent and heavy traffic, the road-building material, which must then be of superior quality, is in part brought from distant quarries; for instance, basalt is brought from Bohemia.

Water-ways (in this case the river Elbe) are, wherever practicable, chosen for the transportation of such material, thereby greatly reducing its cost.

The stone from Bohemia is even transported as far as Leipzig. The kinds of stone principally used for the construction and repair of roads are the following: Syenite (for paving), coarsely grained granite (for paving), finely grained granite (preferred for paving), quartz-slate (used for repair, excellent material but rare), quartz (use very limited), sandstone (use very limited), greenstone (excellent material), porphyry (most *universally* used in Saxony), basalt (is considered the best stone), coarse gravel (screened), pit (mine) gravel, and river sand.

The coarse gravel, cleaned and passed through a screen and broken to an egg size, is used on state roads on which the traffic is light and less frequent, and also to a great extent on country (communication) roads in flat country, when a more adaptable stone material can not be found in the neighborhood.

Pit gravel and river sand are used for covering the road surface, and serve as a joining material when the smaller broken stone layer is rolled tight. Where sand is not obtainable finely pulverized stones, slags, and sandy loam may be used for this purpose.

All the stone materials as enumerated above are obtained by the Government board for road construction partly from the Government quarries, the latter being leased to private contractors for the purpose of breaking and transporting the stone, and partly from quarries owned by other parties against payment of interest.

In frequent cases contracts are made by the board of road construction with these owners of quarries or with other private contractors to deliver the coarse broken stone and the small broken stone ready for use to the place of construction or, at least, to the nearest railroad station. (This refers to Bohemian basalt transported to Dresden or Leipzig.) The price of such material varies according to its value, to the greater or smaller difficulties encountered in the quarry where obtained, and to the distance of transportation.

The price for coarse stones from the quarry vary from 2.30 to 9.20 marks per 1 cubic yard (3 to 12 marks per cubic metre) and for small broken stone from 3.80 to 13.80 per cubic yard (5 to 18 marks per cubic metre), including the costs of transportation to the place where the material is used.

The average price may be fixed: For coarse broken stone and small broken stone at 4.60 to 6.10 marks per cubic yard (6 to 8 marks per cubic metre).* Coarse gravel costs about 2.30 marks per cubic yard (3 marks per cubic metre).

The rock substructure foundation or packing layer, on which is spread the layer of small broken stone, may consist of softer stone, but in all cases it must resist the effects of frost.

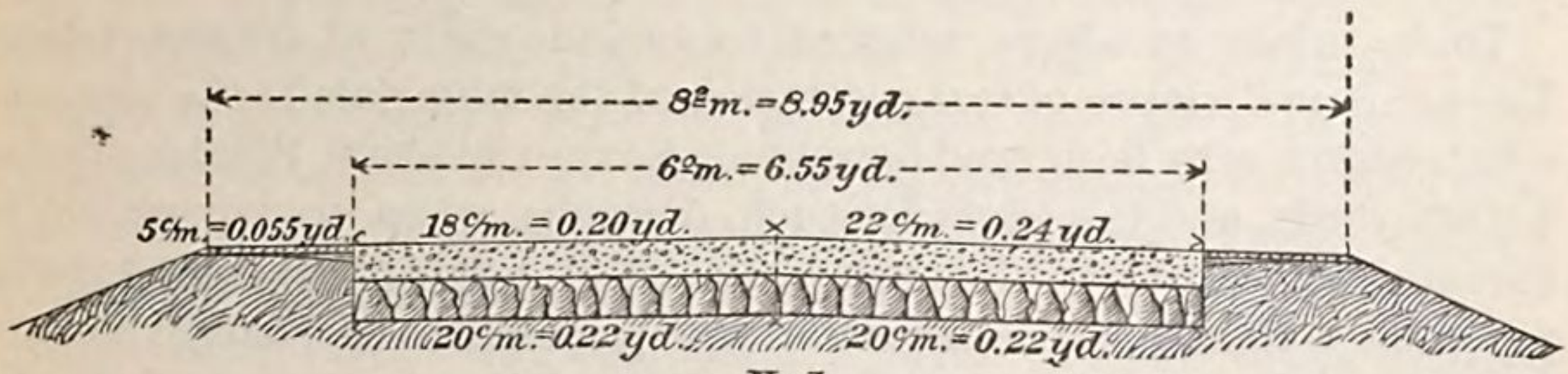
A still softer stone is used, and its price amounts to 3.80 marks per cubic yard (5 marks per cubic metre). The costs for road construction vary according to whether high-priced or low priced material is used, further to the general local conditions, and to whether the road be intended for heavy or light traffic, and finally to the width of the road surface. The costs of maintenance and repair are greatly influenced by the frequency and the weight of traffic.

The width of the state roads varies between 7.7 and 11 yards (7 and 10 metres), giving an average of 9 yards (8.2 metres). The following two diagrams illustrate the heaviest and lightest system of road

* These stones are only broken by hand with iron hammers; stone-breaking machines have been tried, but without satisfactory result.

building all constructions showing different figures are classed between these two.

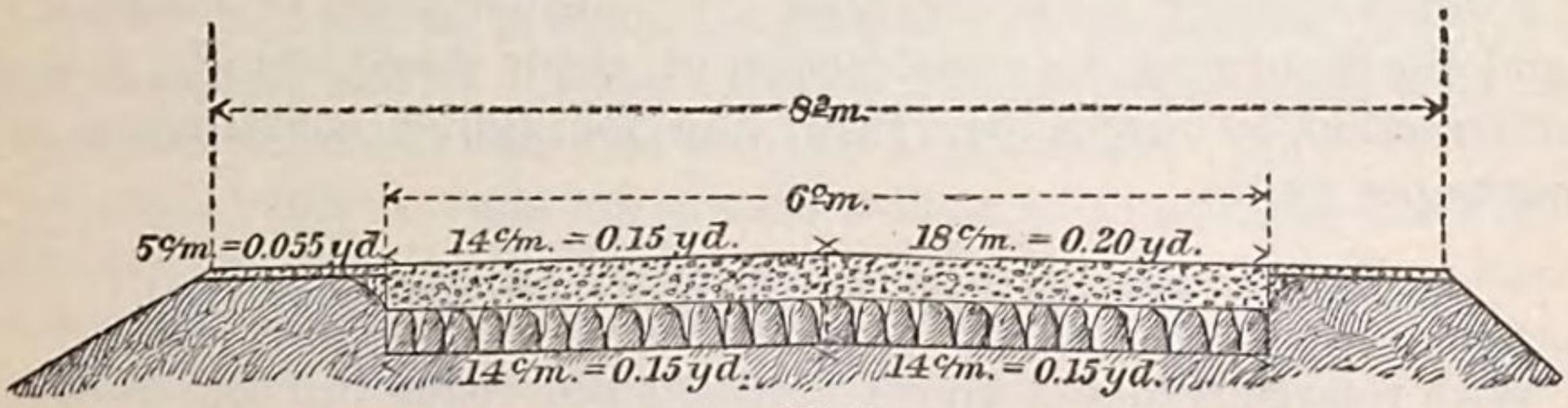
The costs for the heavier construction, which, however, is less frequent, as illustrated in diagram No. 1, are calculated at 27.43 marks



No. 1.

per yard, medium width.

The cost for the lighter construction, as shown in diagram No. 2, is



No. 2.

20.07 marks per yard, medium width.

The above two figures may be specified as follows:

	Marks.
1 cubic metre of coarse stone, for delivery from quarry, to be broken up	6.00
Piling up in regular heaps along the side of road	0.30
Breaking stone	2.20
Spreading stone and covering with sand	0.60
Sprinkling with water and rolling tight	1.30
Total cost for 1 cubic metre	10.40

Now 1 square metre of road surface requires 0.22 cubic metres of small broken stone, 0.22 cubic metres of coarse broken stone (for packing layer), and 0.08 cubic metres of sand. Whereas:

	Marks.
0.22 cubic metre of small broken stones delivered and ready for use at 10.40 marks	2.29
0.22 cubic metre of coarse quarry stones (packing layer), delivery and measuring, at 5.30 marks	1.17
For grading 1 square metre of surface and setting the coarse or packing stones.	0.44
For delivering and measuring 0.08 cubic metre of sand	0.26
For supervision of construction, wages, insurance, etc	0.84
Total cost for 1 square metre of road	5.00

One square yard of road, heavy construction, would therefore cost 4.18 marks.

The lighter system of construction would require per square metre 0.18 cubic metre of small broken stone and 0.16 cubic metre of coarse stones (packing layer) and 0.26 cubic metre of sand, the total cost thereby being 3.34 marks per square yard (4 marks per square metre), based upon the same calculation.

These prices, as above referred to, include costs of transportation. The average distance of transportation of the materials to the places of construction may be figured for roads in Saxony at about 12 kilometres= 13,000 yards, and the costs for such distance, when transportation is operated by teams (which is mostly the case), would average at 4 marks per cubic meter (3 marks per cubic yard), inclusive of loading and unloading. The sand for covering the stone layers is brought from the nearest vicinity as possible—average distance being 3 kilometres (3,300 yards), and costing 1.50 per cubic metre (1.15 marks per cubic yard), including loading and unloading.

After deducting such expenses for transportation of material and sand the total cost for construction of roads would be: For stronger construction, 19 marks per yard, and for lighter construction 13.30 marks per yard.

CONSTRUCTION OF STATE ROADS (LIGHT AND HEAVY SYSTEM).

With reference to the above figures state roads are constructed as per the following details:

As soon as the road body has been drained, prepared, and profiled, carefully smoothened and graded according to the desired level and width, the large stones for the "packing layer" and the small broken stones are brought to the place of construction.

These stones are piled up on both sides of the road in such quantities as may seem sufficient for the thickness of the different layers; the small stones are then broken into pieces of as near cubic size as possible, measuring 0.066 yard (6 centimetres), the other materials, as sand, gravel, and slag, are in the meantime carried to the place for use. The road bed, which, as above stated, has been carefully graded and smoothened, is rolled tight and rammed, and then the coarse packing stones are set in the same manner as described in the beginning of this report. (See Macadamized city streets.) The completed "packing layer" must form a solid and resisting stone body, equally thick and perfectly smooth on its surface.

To secure quicker drainage of the road bed in cases when the soil below the "packing layer" does not permit the water to soak in, transverse trenches 20 centimetres wide and 15 centimetres deep are dug beneath the packing layer at intervals of 11 yards (10 metres) and are filled up with loose stone and gravel. These trenches conduct the water out of the road bed into the side ditches.

A good drainage of a road and its substructure is the principal condition for an effective and cheap maintenance of a macadamized road.

Wherever practicable all roads should be higher than the level ground, and the side ditches should be at least 0.55 yard deep by 0.44 yard ground width.

Old state roads, in regions where stone is scarce, are often not provided with a packing layer, the layer of small broken stone having been simply spread over the old gravel surface. Such roads, when carefully and continually repaired, may stand the heavy traffic in dry weather, especially in winter, but in spring they become very soft, and, when drainage is unsatisfactory, they often turn into swamps and are altogether impassable.

The packing layer being completed, a layer of small broken stones that have been passed through a screen, is spread over the former, thus forming the superstructure. The whole is then again rolled tight with steam or horse rollers, without the use of water.

The last covering consists of sand and gravel, which, while continually soaked with water, is again compacted with the rollers. The road is then complete and its surface must be entirely smooth and solid, so that not one stone can easily be torn out or displaced.

New macadamized roads are always a little soft until they have had time to dry out completely; therefore, in the beginning, after they have been opened to public use, the road surveyors must carefully watch that all formations of ruts be prevented.

The quantity of water required to soak the road surface during the process of rolling varies greatly according to dry or wet weather, to the condition of the ground foundation, the thickness of the stone layers, and the quality of stone and of covering material used. A steam roller weighing 10,000 kilograms can compact 40 to 60 cubic metres of small broken stone in about 10 hours, two watering carts, each drawn by two horses, being constantly at work.

While constructing and rolling new roads the engineers must see that the original arched profile of the road surface be maintained, its highest elevation being from one-sixtieth to one-fortieth of the width of the road.

Roads on very flat country, constructed with inferior material and not kept very carefully, this referring especially to country (communication) roads, must be more arched than state roads.

Country roads subject to heavy traffic should have a stone bedding (packing layer and macadamized surface) 0.29 yard (26 centimetres) thick, when the stone used is soft, and 0.22 yard (20 centimetres) thick when the material is hard, whereas on country roads with but little traffic the layer need only be from 0.22 to 0.17 yard (20 to 15 centimetres) thick.

On roads with light traffic a layer of coarse broken stone can replace the packing layer, these stones being cubic shaped not exceeding 0.08 yards in size. The small broken stones are then placed on this layer. The incline of important roads on level country must not exceed 1 in

40, in mountainous regions not 1 in 12 to 1 in 15; on the other hand, it is not advisable to construct entirely horizontal roads on account of their drainage.

The carriage road being completed, both the sides, of which one serves as footpath, the other being reserved for the storage of repairing materials, are covered with a gravel layer from 1.1 to 1.6 yards (1 to 1.5 metres) in width, and 0.055 yard (5 centimetres) thick, and rolled tight. The costs for this work are averaged at about 36 pfennigs per square yard (40 pfennigs per square metre).

ROAD TREES.

In order to mark out the border of the roads and make it discernible at night, also after snowdrifts to warn the public against the embankments or other danger, trees are planted along all public roads. This is a prescription of the law and must be strictly adhered to.*

Fruit trees such as apple, cherry, pear, and plum trees are preferred and are planted in flat as well as in hilly country, wherever the climate and local conditions permit such trees to grow. The trees are planted at a distance of 6.6 to 11 yards (6 to 10 metres) from each other. The keeping and nursing of road trees is intrusted to the road surveyors. These fruit trees are leased, and at times yield a crop worth 100,000 marks and more per annum. The costs for planting a road with grafted fruit trees averages, at 0.76 mark per yard 0.80 mark per metre; with wild trees, 46 pfennigs per yard (50 pfennigs per metre).

As an addition to the foregoing paragraph on "costs for road construction," it may be well to state that it is impossible to give the exact cost of the preparation of the road body, as this depends entirely upon the local conditions; but in flat country, where the principal work consists in digging the side ditches and strengthening the slope of the ditches and the border of the road by sowing or patching with grass, the average cost for such works would be figured at 1.65 marks per square yard of road (1.80 marks per metre).

MAINTENANCE AND REPAIR OF STATE AND COUNTRY ROADS.

The maintenance and repair of state and country roads consists principally in the renewal of the surface (superstructure) that has been deteriorated and worn off by the action of the weather and the traffic.

For this purpose the roads are, at certain intervals from 3 to 15 years, according to the frequency of traffic, local conditions and climate, covered with a massive layer of small broken stone which is thoroughly rolled with steam-rollers, as already described. This layer of small broken stone must be 0.16 yards (15 centimetres) thick, and the stone used must not exceed 0.05 yards in size, thus being smaller than for new roads. The total length of all state roads in Saxon is figured at

* There are but few fences or hedges along the roads or dividing fields, in Saxony.

4,050,000 yards (3,703 kilometres), of which 31,000 yards (28 kilometres) are paved, the rest macadamized. Only about one-eighth of this entire length is covered with a fresh layer of stone material during the course of a year. On all other roads very little repairing is required. Per 1,000 yards of all macadamized roads, 43 cubic metres of small broken stone and 13 cubic metres of covering material (sand, gravel) are used, in average, per annum.

The quantity of such material used on single tracts of road, however, is very irregular, and varies, according to the wear and tear, from 18 to 170 cubic metres per 1,000 yards. Besides the regularly repeated general repairs by covering the entire surface of the road with a massive layer of broken stone, local repairs are continually necessary, as filling out ruts and depressions with small broken stones, which serves to keep the road surface comparatively even until the time for the general repair.

Such local repairs are made mostly during the rainy season, when the ruts and depressions fill up with water and interfere with the traffic. The stones used are small, about 0.03 yard (0.04 centimetres) in size, and after spreading they are covered with sand and gravel and rolled tight.

The further consolidation of such repaired spots is then left to the traffic, teams and vehicles being, on such repaired tracts of roads, ordered to pass over that portion of the road.

It is the duty of the road surveyors, together with the road laborers, to keep the surface of the road scrupulously clean. The dust and mud is swept and scraped off the road surface by means of hand-scrapers, brooms, etc., and deposited in piles along the side of the road, and then collected in carts and carried away.

Larger apparatus for cleaning purposes (revolving cylindrical street sweepers), drawn by horses, are only used in the vicinity of cities.

The guards and road laborers, above referred to, must also keep the ditches in good operating condition; they must further take good care of the road trees.

In winter they must shovel the snow off the road, so as to keep a track open for traffic. The roadguards are permitted to exercise, to a certain extent, the duties of the road police service, in order to facilitate the traffic and protect the roads, as prescribed by the regulations referring thereto.

It will not be necessary to refer in detail to the paved tracts of state roads, as this would only be a repetition of what has been said about paved city streets.

MAINTENANCE OF STATE ROADS.

The costs for maintaining the entire length of state roads in the Kingdom of Saxony, viz, 4,050,000 yards, averaged during the years 1880 to 1885 52 pfennigs per yard of road per annum, of which 48 pfennigs

was for the maintenance of the entire road surface (including footpaths); .015 pfennig for repair of structures; .02 pfennig for the nursing of the road trees, and .005 pfennig for miscellaneous expenses.

These costs have, since 1885, increased to .55 pfennig per yard.

The expenditure for salaries and clothing of the road guards was figured during the said years at .145 pfennig per yard, and 3 pfennigs per yard for official roadmasters and surveyors.

The building of state roads, as well as the construction of navigable ways and the building of houses and railroads, are under the supervision of the third department of the "Royal finanz ministerium" (treasury department). A special technical director for road-building is attached to this department.

There are in Saxony 17 districts for the supervision of roads and water ways, embracing usually two "amtshauptmanuschaften" each. The duties of the directors of these districts are to draw up the plans for and supervise the construction of the state roads and of the navigable ways, and also to attend to all technical matters connected therewith. They are supplied, as the case may require, with a number of engineers and government architects.

Saxony is further divided into 76 road-master districts, so that from 4 to 5 road masters stand under each district surveying director. These road officials must survey and conduct the works for road repair, and are intrusted with the control of all the road guards, 811 in number, throughout the entire Kingdom of Saxony.

The road guards have from 3,000 to 7,000 yards of road (in average about 6,000 yards) each to repair, clean, and survey; in case of necessity one or two day laborers are placed at their disposal for assistance.

When a general repair of a road is undertaken, with the use of a steam roller, fifteen to twenty extra men are required for such work, so that the repair be completed within the shortest possible time. In such cases several divisions of road laborers and road guards are temporarily called together and are superintended by a road master.

In case of construction of a new road the road guards and road masters must promptly report when called upon.

All treasury matters are handled by the department, which is entirely separate from the technical department. This department, called "bauverwaltereien," whose directors recently are mostly custom officials, handles also the treasury matters for public buildings and water constructions.

The police service on the roads is executed by the amtshauptmannschaften, the latter forming part of the department of the interior. They superintend the entire rural police force, and are consequently the superior authority to the road masters and road guards, who, with the assistance of the other police officials, perform the duties of the road police service.

Considering that the duties of the different administrative depart-

ments are so closely connected with each other, it is not possible to state the exact sum expended for the supervision of state roads separately, therefore only the following figures can be given:

The present annual sum expended for the use of the "finanz ministerium" (ministery of finances), including offices, stationery, main cash and paying office, bookkeeping, accounts and calculations, may be stated as being 2,000,000 marks in a round sum, and the average annual expense for the use of the administration of road and waterway construction, 4,814,000 marks in a round sum. The latter sum embraces all costs for maintenance of roads, bridges, and other structures, expense incurred by regulating the river Elbe, and also the following detailed expenses:

	Marks.
Salaries:	
Academically studied officials:	
2 technical "Bauräthe" (members of the board for public construction) at 6,600 marks each per annum	13,200.00
19 inspectors for roads and navigable ways at 3,300 to 4,800 marks; 19 government architects and assistant architects, at 2,100 to 3,000 marks	122,200.00
Inferior officials:	
76 roadmasters (for building and maintenance), at 1,500 to 1,800 marks	151,900.00
811 road guards at 660 to 720 marks	546,400.00
Technical assistants:	
Assistants for technical works and roadmaster candidates	19,000.00
	852,700.00
Special compensations:	
For clothing the inferior officials	62,300.00
Miscellaneous extra expenses	9,100.00
Gratifications	8,400.00
Contribution to protection fund	103,700.00
Other assistance	49,000.00
Hospital taxes, insurance against accidents and old age	16,000.00
Expenses for service, day wages, and traveling expenses	122,000.00
Miscellaneous petty expenses	20,000.00
Removing of snow	170,000.00
Correction and new constructions of roads and bridges	805,000.00
Total	2,218,200.00

Costs for maintenance of roads and planting of trees amounted to 2,210,200 marks.

Sum paid to the bauverwaltereien (offices in the departments), 91,500 marks.

All country roads, as prescribed by the law of January 12, 1870, must have a width of 5.5 yards (5 metres) in open country, and of 7.6 yards (7 metres) within villages and small towns. The width of the macadamized portions of country roads if, as above stated, their total width is 5.5 yards, would be about 4 yards, or 3.6 metres.

The costs of construction of country roads having a stone bedding as

above described, would average both for light and heavy traffic from 10 to 7 marks per running yard. All roads within villages and smaller towns are under the supervision of the magistrate and common day laborers are employed for their maintenance. The average wages of a road laborer may be figured at 2.50 to 4 marks per day within Dresden and other large cities. In the country, where living expenses are lower, the laborers do not get more than 2 to 3 marks per day.

In some cases the supervision of country roads within villages and their repair is transferred, against extra remuneration, to the road masters of the respective districts. Such road masters must be officially authorized for this purpose.

In second instance the country roads are surveyed by the amtshauptmannschaften, that is to say, by their police forces and road masters. In single cases, however, the parishes of an amtshauptmannschaft (*i. e. Dippoldiswalda*) will unite to one corporation for the purpose of mutually maintaining their roads. Such work of repair, etc., is done by special road guards, and also in part by day laborers. The costs therefor are borne by the parishes. All the state roads, however, are maintained at the cost of the general government.

The toll on state roads was suspended 4 years ago, as the revenue did not represent one-tenth of the funds required. A very few par. ishes contribute small sums of money or provide road-building material, this being in single cases prescribed by an old law.

There are no special taxes for road building and repairing; the funds required are taken from the total revenue of the state.

A special provision of the law prescribes that the parishes must supply the necessary laborers for removing the snow from state as well as country roads on their entire width if practicable. The country roads are maintained at the cost of the town and village parishes and of the independent manor holders.

In small villages it occurs quite frequently that the costs of repair are borne entirely by the "altgemeinden" (old communities). These altgemeinden were composed of a number of owners of old farms that had existed before the building of the village, while all later farm owners and tenants are exempt from such duties.

Persons that make an exceptionally frequent use of a public road, such as owners of quarries, mines, and brick factories, using their own teams for transportation purposes, can be held by the law to bear the expense of maintenance and keeping of such portion of road.

Poor communities, which, according to local circumstances (such as communication to railroads) are subject to considerable costs of maintenance of their roads, are supported with funds by the amtshauptmannschaft or by the state's treasury.

In such cases also the costs of communication roads that are being newly built or improved by reason of an increase of traffic, are partly or wholly borne by the state's treasury. The communities are gener-

ally held to deliver building material and the necessary land without compensation. Such roads when completed are turned over to the communities (parishes) for maintenance.

The principal advantage that is offered by a good and well built road consists in the possibility of transporting considerable loads at a comparative moderate expense. This fact naturally extends the market and increases the prices of all agricultural and mining products, such as stone, coal, brick, etc.

It must be admitted, however, that on one hand the importance of the principal roads, serving for through traffic, has been seriously if not entirely destroyed by the railroads; yet, on the other hand, because of the rapid increase of population, the traffic on the roads that connect one or more small villages or towns shows a decided increase.

Even at present most of the agricultural products are transported by teams over distances exceeding 20,000 yards without the use of the railroads.

Further, all country roads serving as communication to the railroad stations are of great importance, because the transportation of freight by rail is more or less dependent on the road traffic. Higher prices of all products naturally cause an increase of the land value, which, however, in the country is not as apparent as in cities.

The country roads, as well as other means of transportation and communication, represent an important part of the foundation for the welfare and civilization of a nation.

A comparison between the costs of city streets and country roads can only be made in reference to macadamized roads. The costs of construction of both do not differ very much.

A macadamized city street costs on an average about 3.76 per square yards, whereas the two kinds of macadamized country roads average 3.26 marks.

The difference is not great, and is explained by the fact that the wages within a city are considerably higher than in the country. It is different, however, with the costs of maintenance. In Dresden the average annual cost for maintenance of one square yard of street amounts to 15 pfennigs. On government roads, however, the costs of maintenance of one running yard, inclusive of wages of road guards of 62.5 pfennigs on 6,546 yards width of road, amount to 9.55 pfennigs per square yard.

This great difference of costs may be explained, firstly, by the fact that the traffic on country roads is by far inferior to that in the cities. Secondly, besides the above-mentioned difference of wages on country roads and in city streets, it may be stated that the materials for maintaining and repairing the country roads are by degrees during the winter stored along the side of the roads, and prepared for use (breaking and screening). Under such circumstances laborers and drivers can be obtained at much cheaper wages. Thirdly, the material for re-

pair is, for country roads, taken from the nearest neighborhood, while in cities it is stored away in the storage grounds, to which it must be transported from considerable distance. The three points as enumerated give, undoubtedly, sufficient explanation for the large difference in the costs between maintenance of country roads and of city streets.

Regarding the use of the roads it has already been said in the beginning of this report that the roads are open to traffic of every description. This practically is the case, but there are a few restrictions to this general rule, which it may be well to mention.

Powder and other explosive materials can only be transported under special instructions and in special wagons, and such transports must be escorted by police officials. (Acts of the Department of the Interior dated November 3, 1879, November 22, 1884, and December 23, 1885.)

The transportation of road locomotives, steam rollers, etc., is also subject to special regulations (acts of June 9, 1860, and September 26, 1883). For such transportation a permission from the police authorities must be obtained, and an escort of road guards is required. For transportation of long logs of wood or planks, the act of July 9, 1872, prescribes that, besides the driver, such team be accompanied by a second individual, who must properly guide the rear truck.

The act of April 16, 1840, prescribes that teams for heavy loads, such as coal, bricks, earth and stones, must have a width of tire of at least 10½ centimeters (.115 yard). The same act provides that all vehicles must have a flat and not rounded surface of tire. Wagons with nails or other fastening parts protuding from their tires are not allowed to enter the road at all.

The same law provides that all light vehicles (transportation of persons) must have a width of tire of at least .073 (6.5 centimeters) yard. The greatest pressure of the wheel on the road surface must not exceed, for heavy wagons, 2,500 kilograms in summer and 3,000 kilograms in winter, excepting for transportation of loads that can not be divided (like steam boilers, trunks of trees, etc.).

The stadträthe (town councillors) and the amtshauptmannschaften have the right, according to the law of July 9, 1872, referring to traffic on public roads, to issue special rules on certain roads in certain districts for the protection of the traffic; they can also direct certain vehicles to pass on certain roads. Very little use is made of this law.

Wagons that exceed 8,500 kilograms, inclusive of weight of the wagon itself, are not permitted to pass over older wooden bridges.

The same law provides that the width of a loaded wagon must not exceed 2.8 metres, that is to say the load must not extend beyond such width. In exceptional cases a special permission from the police authorities is necessary.

In conclusion, attention is called to the following books issued by the Government and published in Leipzig, and obtainable at the Rossberger-'sche Verlagsbuchhandlung:

"Die Gesetzgebung über Wegebau und Expropriation im Königreich Sachsen" (the legislation concerning road building and expropriation in the kingdom of Saxony), by Ludwig Wolf. This book contains all the rules and regulations regarding the traffic on roads and the manner of the execution of such laws.

Uebersicht der im Königreich Sachsen zur Chaussée Unterhaltung verwendeten Gesteinsarten, Dresden, 1869. (Tabular statement of all the species of stones used for maintenance of roads in the kingdom of Saxony.) This book contains exact information regarding the origin and qualities of road-building material used in Saxony.

Die Organisation der Behörden für die innere Verwaltung vom 21. April 1873 (the organization of the authorities for the interior administration), and, "Revidirte Städteordnung, bez. Revidirte Landgemeindeordnung" (revised city regulations and revised regulations for country parishes), containing all laws and regulations regarding the administration of country roads. The latter two books have been referred to in a previous part of this report.

AULICK PALMER,
Consul.

UNITED STATES CONSULATE,
Dresden, June 29, 1891.

STETTIN DISTRICT.

REPORT BY CONSUL KELLOGG.

STREETS OF STETTIN.

The streets of Stettin (116,000 inhabitants) up to some years ago were mostly paved with common paving stones obtained from erratic bowlders irregularly cut with a flat head, the price of which when set was about 14 to 15 marks per square metre.

In the last five years Stettin, following the wake of Berlin, and the other large cities, has commenced to paveher streets with better material, introducing straight rows of stones instead of curved and broken ones of former years. The city authorities intend, as far as the budget will allow, to have at no distant date the side as well as the main streets well paved with the best material.

The inland quarries not being able to compete with those of Sweden, the best paving stones are hence imported from that country, and especially from the quarries at Carlskaona, Carlshanon, Westerwyk, and Warboy. The Swedish granite is very solid and of fine grain.

The prices of the above stones delivered on the wharfs of Stettin range from 8.50 to 9 marks per square metre.

The granite plates for sidewalks are imported from Christiania and Draunnen, in Norway. The Norwegian granite is of rougher grain,

hard, but splitting easy and well adapted for sidewalk plates. The border and gutter stones are also worked from this variety of granite.

Delivered on the wharfs of the town of Stettin the prices for these materials are as follows:

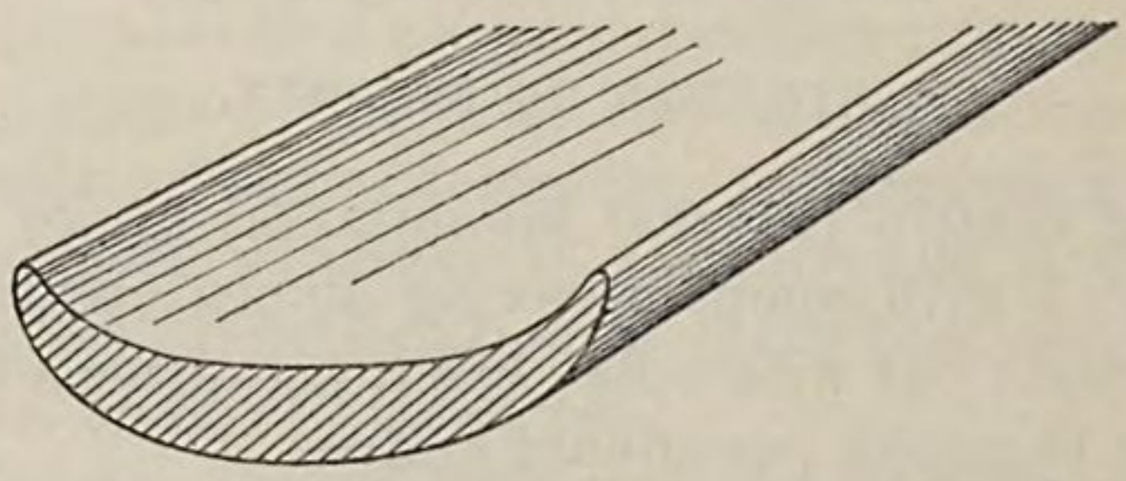
	Marks.
One square metre of granite plates for sidewalks	9.00
One metre in length of granite border stones for sidewalks	4.00
One metre in length of granite gutter stones for sidewalks	2.25

The streets of Stettin, paved with stone blocks as they are, are well adapted for light and heavy traffic. In streets with a declivity of 1 in 100 and less experiments have been made with asphalt pavement 0.05 metre thick, being laid on a granite Beton 0.30 metre thick, under which is a gravel bed 0.20 metre thick. The asphalt paving, including a guaranty of 20 years, costs 14 to 16 marks per square metre.

Best block pavement costs 11 marks per square metre; ordinary block pavement costs 5 marks per square metre; sidewalk pavement (granite plates) 11 to 12 marks per square metre. The cost of keeping the streets in good condition depends upon the amount of traffic.

Formerly the sidewalks consisted of only one line of granite plates about 1 metre wide, and many such walks are still to be found, especially in the older parts of the town; where, however, the streets are well paved with the above-described material the walks are laid out entirely with granite plates.

The edges of the sidewalks were formerly provided with granite gutter stones having in profile the following appearance:



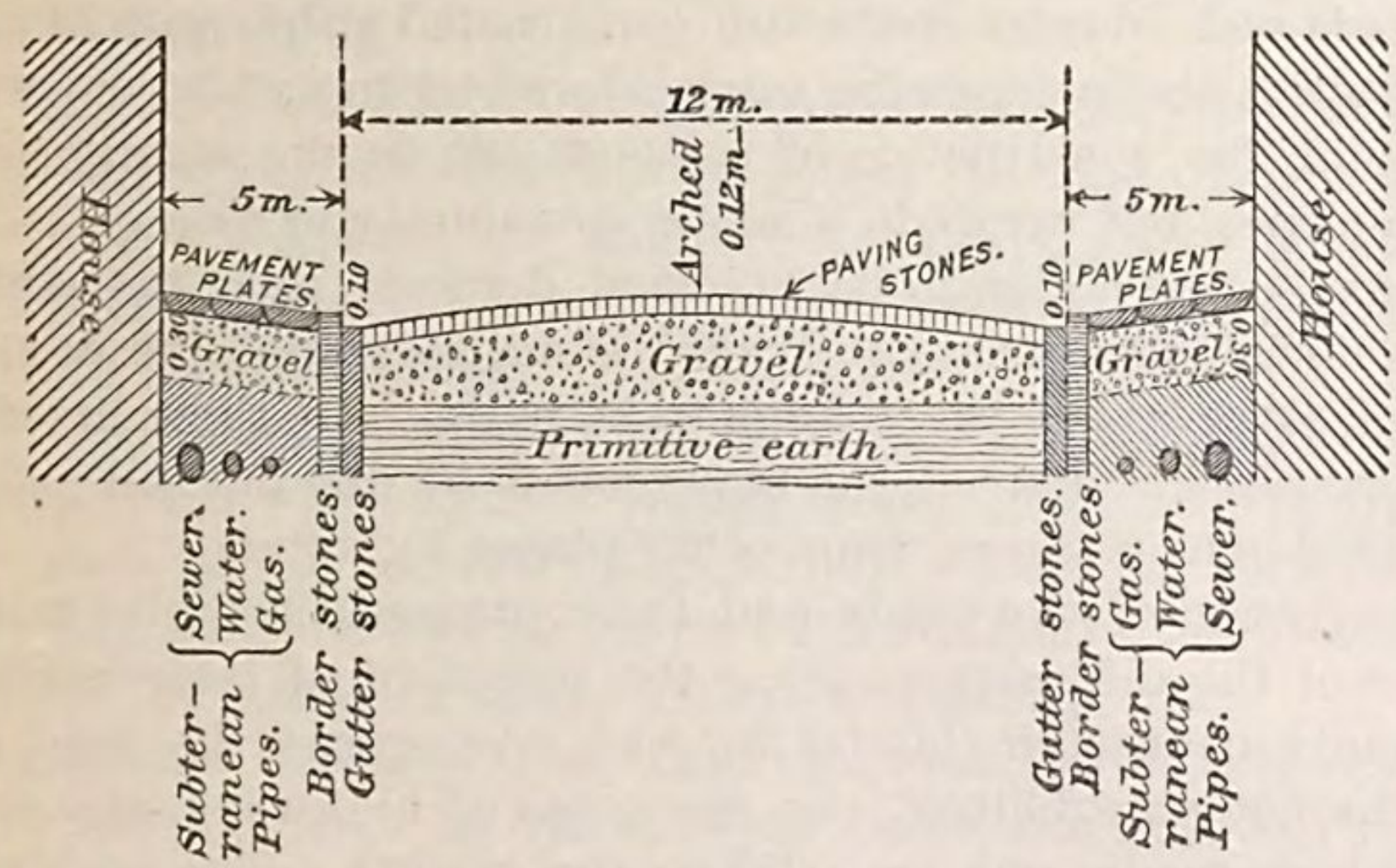
They are now replaced by square granite stones with flat tops laid against the granite border stones at the side of the granite sidewalk plates.

As a foundation for the best paving stones a composite of gravel 0.30 metres thick is employed; for the sidewalk plates a layer of sand is used. After the plates are laid the edges and fissures are cemented with Portland cement.

For keeping the streets in good repair 1 metre quadrannually is reckoned for each square metre of pavement to be provided for from the budget of the city government, whilst property owners are charged an extra amount to keep the sidewalks in good condition or to alter them into the new system.

The expense of cleaning the streets, carrying off dirt, etc., is paid out of a special tax fund, 15 pfennigs per square metre yearly.

Every property holder is compelled to have his sidewalks swept every morning; in the hot summer months they must be sprinkled several times a day, and in the winter season the snow must be swept from the walks, the property holders also having to sweep the snow from the middle of the streets to the sides, and in piles, which must then be carted away. This expense is borne by the property holders. The expense of carting snow away from public places is borne by the people in general, the city authorities generally giving the contract to the lowest bidder.



LONGITUDINAL CUT OF A STREET ETC.

New streets are laid out at the expense of the property holders whose property touches the projected street, who are required to keep them in good condition for four years. After this period the city takes the responsibility of keeping them.

Old streets are preserved and kept in repair by the city alone.

COUNTRY ROADS.

To promote the laying out of high roads and country roads, and keep them in good condition and repair, the budget of the different provinces of Prussia grants a certain sum every year, amounting in the province of Pomerania, of which Stettin is the chief town, to about 400,000 marks ($100,000).

Those counties (kreise) undertaking to construct roads obtain, when the proposed roads are considered a necessity, an allowance of 33⅓ per cent. of the cost of "à fond perdu," 16⅔ to 25 per cent. of the cost to be collected by the county itself, but the remaining 50 to 41⅔ has to be paid by the adjacent property holders, who, however, are reimbursed partly for this by being paid for the assistance they lend in constructing the roads, such as carting sand, gravel, stones, and other material. The adjacents—such as large or small farmers, country towns, or manufacturers, etc.—have to contribute in proportion to the benefits accruing thereby.

If a county has very heavy expenses to meet, such as those accruing from the construction of public works, as high roads and local railroads, etc., it is entitled to issue bonds at a fixed rate of interest, all these bonds to be called in in about 25 years. Each year a certain number of them are canceled, which have been drawn by lot.

The immediate counties of the consular district of Stettin (the counties of Stettin and Randor) have as yet not issued any bonds, but they will soon be compelled to do so as a new local railroad has just been projected.

All high roads and country roads are constructed either with block stones or macadam, the latter being consolidated on top with pounded stone or gravel. The construction of roads is left to the county and district communities, but rarely to a singie community or estate.

The system of construction to be followed depends upon the existence of the material, such as stone, gravel, sand, and upon the condition of the soil over which the road is to be built. As there are no quarries in this consular district, the stone has to be dug out and gathered from the fields or procured from other places by water.

The administration of the roads and their preservation falls upon the authorities of the different counties, the president of their boards being the county counsellor (landrath), who, as regards the road, is assisted by the county architect, the inspector of highways, and the guards of the high roads, who are paid by the county. The expense of laying out new roads, paved with block stone, which is partly borne by the provincial government, which also surveys the whole road, varies from 8 to 20 marks per running metre.

The construction of new roads has always been followed by increased benefits to the farmer as well as to the manufacturer, for it gives them increased facilities for bringing their products and wares to market.

In 1875 the administration and preservation of the roads were handed over to the provincial board, but it has since been transferred to the county board of administrators.

From the accompanying cuts one will see that the roads are built with two objects in view, viz, for heavy and light traffic, and teams accordingly choose that part of the road over which, according to the loads they carry, they must drive.

The foundation beds of these roads consist of unhewn stones 0.20 metre thick, covered with granite pieces 0.25 metre in thickness. The upper part of this covering, 0.05 metre, is composed of small pounded stone covered with a layer of gravel 0.03 metre thick.

The whole is rolled several times with heavy steam-rollers.

JAMES KELLOGG,
Consul.

UNITED STATES CONSULATE,
Stettin, January 22, 1891.

ITALY.

REPORT BY CONSUL JONES, OF MESSINA.

COUNTRY ROADS OR HIGHWAYS.

In Italy the minister of public works sees to the laying out, making, repairing, and police supervision of the national, provincial, communal, and vicerial highways.

Carriageable roads are divided into national, provincial, communal, and vicerial roads.

National roads.—Those which connect the chief cities of the kingdom with each other and with the seaports; the magnificent roads across the Alps and Apennines; and military roads, solely for strategic use. When two cities become united by a railway their national road becomes a provincial road.

Provincial roads.—Those which connect the capitals of different provinces; those which connect the capitals of the respective provinces with the seats of the several districts into which the provinces may be divided; and those which connect the capitals of the provinces and the seats of the several districts with the nearest ports.

Communal roads.—Those which connect the county seats with the other towns in their districts; those which run through villages; and those which run from the county seats to the parish churches, cemeteries, railroads. All other public roads are vicerial roads, and are kept up by the communal authorities.

Ownership.—The land used for national roads is government property; the provincial roads belong to the provinces; communal roads to the communes. The public squares in cities and villages form part of the communal highways. National and provincial roads within the limits of a city or village belong to the communal highways.

Construction.—The government builds and keeps up the national highways. Tolls on these roads have been abolished, except on ferries and floating bridges. The cost of building and keeping up provincial highways devolves upon the provinces, which may levy tolls by royal decree. Provinces may also levy a per capita road tax. In the province of Messina this tax is 4 francs, or 80 cents, or 3 days' work on the roads, per annum and per head. The cost of building and keeping up communal highways devolves upon the respective communes; these expenses are paid out of the communal revenues or by a special tax levied by the communes. The communes have the right to establish tolls, which, however, must be abolished as soon as they shall have realized the cost of the road. The keeping up of such portions of national and provincial roads as pass through a city or village falls upon the commune, the government or province paying over annually to said commune a sum equal to the cost of keeping in repair a stretch of road of equal length near the city or village. National, provincial,

and communal roads are invariably macadamized. A roadbed 20 centimetres (nearly 8 inches) deep is dug out and filled in with broken stones, which, after being well watered, are packed down by means of a heavy roller; a layer of earth of sandy or calcareous character is then added, and when thoroughly rolled is well watered and again rolled until the surface becomes firm and smooth.

The width of national and provincial roads is 8 metres (say 26 feet); the average cost per kilometre 30,000 francs or $6,000. The width of the communal road in 5 metres; average cost per kilometre, 20,000 francs or $4,000. The soil in this district is mostly clay, and a deep foundation is not necessary for a good roadbed.

WALLACE S. JONES,
Consul.

UNITED STATES CONSULATE,
Messina, January 26, 1891.

BOLOGNA.

REPORT BY CONSULAR AGENT GARDINI.

The prevailing method employed in making city streets, at Bologna, and other towns, is the union of flint stones on a bed of sand or on a foundation of sifted gravel.

In many of the principal streets of Bologna, at each side, are placed two bands of granite 0.60 metre of breadth, and 0.20 metre of depth, at the distance of 0.60 metre, in order to facilitate the transit of vehicles.

Flint stones are of elyssoidal form; their thickness varies from 0.09 metre to 0.12 metre; most of them come from the river Reno, and a part from the river Adige; the sand is all taken from the Reno.

The pavement made with flint stones of the Reno, on a bed of sand, including the necessary digging, at the depth of 0.15 metre, costs 1.30 lira per square metre.

The same pavement on a bed of 0.15 metre of sifted gravel, including the necessary digging, at the depth of 0.30 metre, costs 2 lire per square metre.

The cost of a pavement made with granite, flint stones of the Adige, on a bed of sand and of sifted gravel, depth 0.15 metre, including the digging at 0.30 metre is 3.80 lire per square metre.

When a paved street, according to the last method, is also furnished with two bands of granite of only one line, each square metre costs as follows:

Breadth of street.	Cost.	Breadth of street.	Cost.
Metres.	*Lire.*	*Metres.*	*Lire.*
6	10.55	10	7.90
7	9.65	11	7.55
8	8.90	12	7.25
9	8.40		

If the line of granite is double, the prices per square metre are the following:

Breadth of street.	Cost.	Breadth of street.	Cost.
Metres.	*Lire.*	*Metres.*	*Lire.*
6	17.30	10	12.10
7	15.50	11	11.20
8	14.20	12	10.65
9	13.00		

At Bologna there are also a few streets paved with square stones, 0.15 metre in size, of granite, coming from San Fedelino (province of Biella); these square stones are placed on a bed of cement of the thickness of 0.15 metre; its cost per square metre is 30 lire.

The annual expense for maintaining the city streets paved by the aforesaid methods is about 0.12 lira per square metre.

CARLO GARDINI,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Bologna, January 17, 1801.

PROVINCE OF CATANIA.

REPORT BY CONSUL HEATH.

CITY STREETS.

The principal streets in Catania are very good, and the process of making is well worth imitating by cities in the United States. The foundation is of broken lava, $2\frac{1}{2}$ inches and less in diameter, firmly cemented together with burnt clay and lime to the depth of about 8 inches; this is properly crowned and the stones pounded securely into place, presenting an even surface for the pavement.

The pavement in the best streets are of No. 1 hard lava; it is quarried very rough in blocks about 16 by 20 inches and 8 inches thick, and worked upon the spot at time of making the street.

These blocks are laid in cement, the edges being fitted with great nicety.

Driving on such a street is very comfortable. The comparatively smooth surface and large size of pavements give none of those disagreeable jilting sensations such as are common on our own paved streets. The paved streets are much preferred for driving to the country roads by the driving population.

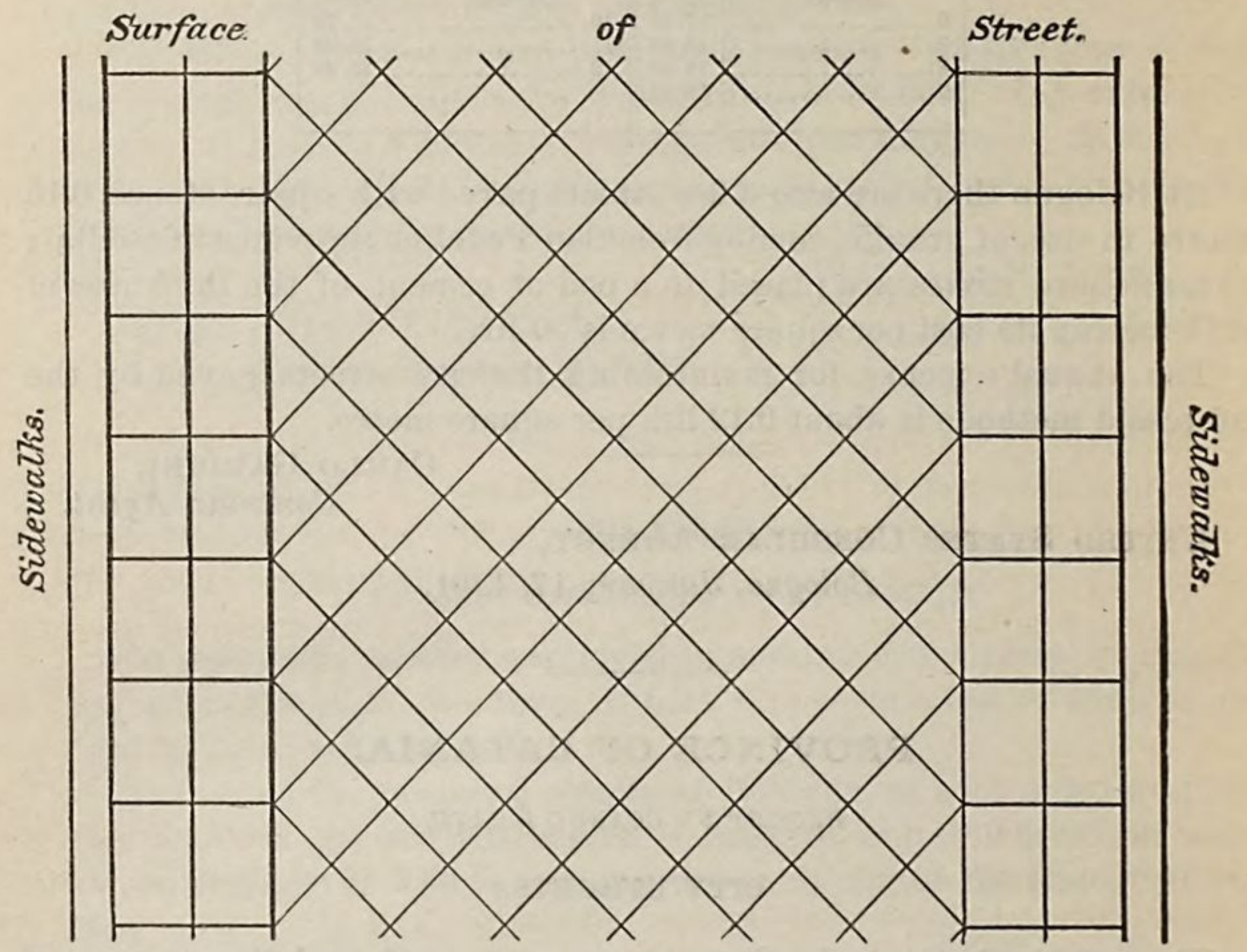
These streets present several ideas which seem to me to be an improvement on our own methods.

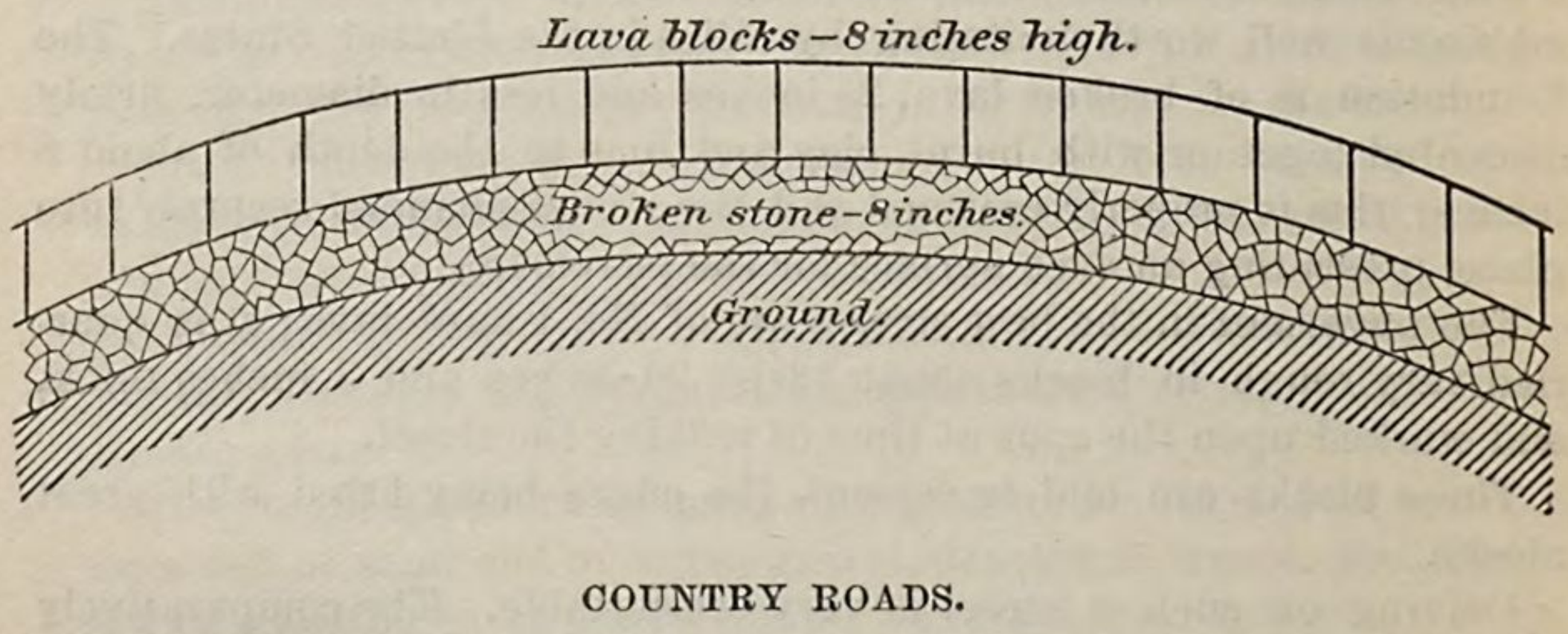
First, the large paving blocks used, giving a superior surface for driving or teaming.

Second, the comparatively smooth surface, with no open joints to hold dirt, making it an easy matter to sweep up all surface accumulations.

Third, the substantial foundation of cement and stone, absolutely preventing any dirt from working up from the ground.

I inclose a small plan of a street as described.





COUNTRY ROADS.

Country roads in the province of Catania are generally poor, and there is no regular process of making them. Only the principal ones can be driven over with a carriage.

Once a year the principal ones are repaired. This repairing is done in the winter or rainy season, and consists of crowning up the center of the road with a thin layer of broken lava, 2½ inches and less in diameter, of the poorest quality. On top lumps of clay are thrown, and frequent rains and constant traffic do the rest.

The poor quality lava gradually crumbles under wheels and hoofs, is finally mixed with the clay through the same agency, and, strange to say, after a few months makes a fairly good road.

This process, however, has no merits excepting economy, and I hope none of my countrymen will try road making on this plan.

CHARLES HEATH,
Consul.

UNITED STATES CONSULATE,
Catania, January 24, 1891.

PROVINCE OF GENOA.

REPORT BY CONSUL FLETCHER.

More than 1,000 years before Columbus discovered the New World this province of Genoa, in which the great navigator was born, and this city, in which he passed his childhood and youth and was contemptuously called the "mad boy," boasted of fine roads and streets. To keep them in good condition at the present day the following methods are employed:

CITY STREETS.

A bed of sand $5\frac{3}{4}$ inches deep; upon this bed cut or worked parallelopiped siliceous stones are laid; they are placed so as to slope gently from center of street to sidewalks. Each block of stone is about $11\frac{2}{3}$ inches wide, $7\frac{2}{3}$ inches thick, and 2 feet $3\frac{1}{2}$ inches in length. The face of each is notched or grooved, so as to afford a sure foothold for horses.

Sidewalks are constructed from similar material as above noted, but the stones are only $3\frac{3}{4}$ inches thick, and rest upon a bed of sand $3\frac{3}{4}$ inches in depth. The curbstones are also from same material. Each stone is 2 feet $9\frac{1}{2}$ inches long, $7\frac{2}{3}$ inches in thickness, and $9\frac{2}{3}$ inches wide. All rest on a diminutive wall composed of ordinary stone cemented with hydraulic lime. The above for comparatively level streets.

Streets of considerable declivity (Genoa has hundreds of them) on which vehicles run are constructed of smaller faced stones, the average measurement of each being about $5\frac{3}{4}$ inches wide, $7\frac{2}{3}$ inches in thickness, and 2 feet 5 inches long. Between each line or row of stone is placed a course of hard brick, called here *da carroggio*, set on edge. This is to give horses a sure foothold. Both stone and brick rest on a stratum of sand $5\frac{3}{4}$ inches in depth.

Experiments have been made recently with small round blocks of oaken wood placed on a sand bed $5\frac{3}{4}$ inches deep, but so recent have these experiments been made that the durability of this style of street pavement is not yet ascertained.

There are fully 1,000 streets in Genoa too narrow to admit of carts or carriages. These streets are constructed of round or oblong flint stones set on a bed of sand $3\frac{3}{4}$ inches deep. Some of those narrow thoroughfares are so exceedingly steep that a pathway about 3.3 feet wide made of brick runs through the center. This style of work is called here *pagliola.* The brick affords a sure footing for pedestrians in rainy weather.

Certain other streets, such as those around the drive known as the Circonvallazione a Monte (circle of the mountain), and those in the suburbs of the city, broken flint stones $9\frac{3}{4}$ inches in depth are placed upon the road-bed; over this mass is drawn by steam power a great roller weighing 10 tons. When the stones are crushed into a fairly smooth bed or surface, water and gravel are sprinkled and scattered thereon, after which the roller is again called into play, and soon thereafter the street is ready for public use. Such thoroughfares are called macadamized roads. The sidewalks on these streets are made in a similar manner to those already described, and vary in width from 6 feet 5 inches to 9 feet 8 inches.

STREET EXPENSES.

Expenses incurred in making streets, sidewalks, and roads, wholly completed. per square foot.

Streets, as per first condition	$1.05.9
Sidewalks, as per first condition	0.55.7
Curbstones, as per first condition	0.26.3
Streets:	
Flint stone, second condition	0.09.5
Brick (Pagliolo), second condition	0.31.9
Broken flint stone (macadam)	0.14.5

If the cost of making streets, sidewalks, etc., as above quoted, seem very low, it should be taken into consideration that all the materials used in their construction can be found close at hand and in great abundance.

COUNTRY ROADS.

Country roads or highways are kept in order on the macadam plan, except that in many places the roller is not used.

A book—paper covers—containing 164 pages, is mailed with this report. It is entitled: "City of Genoa—Office of the Public Works. Special conditions for contract for the ordinary preservation of the streets, conduits, and accessory works." This work is published by the municipal government of the city of Genoa.

JAMES FLETCHER,
Consul.

UNITED STATES CONSULATE,
Genoa, Italy, February 12, 1891.

LOMBARDY.

REPORT BY CONSUL PEPPER, OF MILAN.

Italian legislation as to roads is to be considered distinctively under four heads: National, provincial, communal, and viccinale or neighborhood roads. There are subordinate roads of a private character of which the legislature takes no interest in or supervision of. These are under the control of local landholders who have small properties, and who build these roads for their own accommodation. The mode of building and the expense of the roads in Lombardy is uniform, the essential difference being the reasons existing upon the special locality in which the roads are running, namely, in a mountainous region the expense would be greater than in a plain open country.

In general roads in villages or near cities are paved with gravel taken from the beds of rivers which traverse the country. In the cities and in the large towns the ground is also paved. Nearly always the sidewalks are paved with these pebbles for the use of pedestrians, both sides of streets contiguous to which carriages and teams pass are similarly paved. Roads for vehicles are usually from 50 to 75 centimetres in width. The pavements are likewise of the same material, arranged on each side of the streets. Frequently instead of one row of these stones, two or more often come in contact, thereby connecting these streets together. The double roads are usually of stone varying from 50 to 70 centimetres in width, and the sidewalks are of the same width and of the same material. The sidewalks of towns and cities are widened in accordance with the taste and wealth of the proprietors. In the construction of these roads heavy pebbles are placed upon the earth, which contributes solidity and permanency, also contributing to the dryness and to the freedom from the effects of rain. This bed of heavy pebbles furnishes a strong superficiality, which helps the character of the pavement. The expense of the pavement is calculated at 1½ francs per cubic surface. Those of the pavements denominated grades for trams cost 20 francs per cubic surface.

It is understood that roads in Lombardy are everywhere provided lengthways with a channel into which the water runs. This is said in regard to the leading roads. Those in the open country are constructed in the same way, the water running on both sides for the mountainous localities. There is no gravel; the lack is supplied by stones or fragments obtained from rocks. There is the only difference in these roads in width. The national roads are usually from 8 to 9 metres in width, the provincial roads 6, the communal 5. Nevertheless, in the mountainous regions a similar width is tolerated, as also in the commune, the construction of which is obligatory in accordance with the law of 1868. However, this law is not generally obeyed in Lombardy, because the street system has existed for many years, and has reached a splendid development. The triple distinction of roads between national, provincial, and communal has reference solely to the construction and

maintenance by the national government. The provincial roads are built and sustained by the provinces; the communal by the communes; the national by the government. In general, all these roads may serve for purposes of great traffic. This advantage arises from the uniformity with which they are built. The communal roads being the principal ones, it follows that the traffic is the greatest.

It is impossible to furnish the exact cost of roads built in the open country, as it is termed by the Italians, because of the variety of the land, as it is more or less mountainous. In Lombardy, especially, where the great abundance of canals exist and the consequent need of roads to cross them, the building of palisades and walls make it very difficult to get at the expense. About one-half the country is included in what we have seen and the other half in the mountainous zone. Difficulties increase and the expense becomes greater where rocks are to be blasted. In the completion of these roads it is calculated that the expense of roads in Lombardy vary from 2 to 5 francs, and in some instances much more, per metre. This does not include the expense of the ground. It follows, from the data which I have gathered, that the provincial roads built in the last 30 years in Lombardy cost 35,000 francs a kilometre; that the communal average 7,000. Regarding the support of these roads, I am assured that for the communal, 60 to 80 cubic surface gravel per year for each kilometre. The provincial and national being wider and the traffic greater, there is from 100 to 400 cubic surface each year per kilometre. In fine the expense of maintenance varies from the minimum of 250 to 300 francs, and frequently increases to 1,000 francs per kilometre. The condition of roads of all descriptions in Lombardy is far superior to that of any other part of Italy. In a word, the area of this district, Lombardy, is 23,600 kilometres cubic surface, counting 20,000 kilometres for ordinary roads, national, provincial, communal, that is 20,000 kilometres of roads. Lombardy has 1 kilometre of roads for every superficial kilometre. Three-fourths of these roads, 15,000 kilometres, belong to the communal category, the balance, nearly 5,000, are provincial, while the national are only about 500 kilometres.

GEO. W. PEPPER,
UNITED STATES CONSULATE, *Consul.*
Milan, Italy, January 24, 1891.

MESSINA.

REPORT BY CONSUL JONES.

CITY STREETS.

The municipality of Messina, upon the advice of the city surveyor, draws up a schedule of prices, with the maximum wages for day laborers, hire of teams, prices of lime, stone, etc. Sealed bids, based upon

a reduction of so much per cent. on the aforesaid schedule of prices, are handed in and the contract for paving the streets is given to the lowest bidder.

There are four kinds of pavements in use: (*a*) Pavement made of paving stones, different sizes; (*b*) pavement made of cobblestones; (*c*) pavement made of pebbles or chippings; (*d*) pavement made with longitudinal and transverse lines of paving stones, the intervening spaces being filled in with cobblestones.

The streets are divided into three classes: (1) Streets with a horizontal, flat surface; (2) streets with a convex surface; (3) streets with a concave surface.

Three sizes of paving stones are used: (1) Dressed paving stones must be not less than 20 centimetres thick or deep and the sides from 20 to 50 centimetres long; square blocks of stone (lava) are generally used. The length of a block must at all events never be more than twice the width of the block. (2) The thickness of the paving stones, when dressed, must not be less than 15 centimetres and the sides not less than 20 centimetres nor more than 40. (3) The thickness must not be less than 12 centimetres and the sides not less than 20 nor more than 35 centimetres.

Curbstones must not be less than 70 centimetres long.

The sides of the paving stones must be at right angles with each other. The four sides of the first size paving stones must be worked smooth for a depth of 10 centimetres so that the adjacent blocks may fit closely together. The sides of the second and third sizes of paving stones must be worked smooth for a depth of 7 and 6 centimetres, respectively.

The excavation made prior to laying the pavement must be deep enough to contain the paving stones and allow for the bed on which they rest. The bottom of the excavation must be well rammed down with a heavy maul, and, if the ground should be soft and dry, it should be well saturated with water and rammed down whilst wet. The four kinds of pavements in use are: (1) Dry paving (lastricato a secco). The bed is formed of a layer of sand at least 20 centimetres deep, into which —having been well watered—the closely fitting paving stones are placed side by side. The joints, free from sand, are filled up with mortar made of pulverized hydraulic lime. (2) Paving with mortar (lastricato in malta). The paving stones are placed on a bed of mortar, the joints being filled up as above. (3) Paving with mortar on a bed of concrete. A layer of concrete (made of cement and small pebbles) not less than 20 centimetres deep is spread over the bottom of the excavation, and on this concrete the mortar and paving stones are embedded as in No. 2. The joints between the stones must not exceed 2 millimetres and should always be filled in with mortar. (4) Paving with cobblestones. The cobblestones (of granite or quartz) are oblong and so chipped with the hammer as to fit closely one with the other. The

length of these cobblestones is never less than 15 centimetres. The ground being prepared as for paving stones, the cobblestones are set in a bed of sand at least 10 centimetres deep and then covered over with sand, and having been thoroughly saturated with mortar, are well rammed down. Sometimes cobblestones instead of being set in a bed of sand are set in a bed of mortar.

The Messina municipality's latest price list for wages, paving materials, etc., is as follows:

Workman (stonecutter)	per day	$0.60
Day laborer	do	.40
Boy	do	.24
Women	do	.20
Wheelbarrow (hire of)	do	.01
One horse, cart, and driver	do	1.20
Two-wheel ox-cart, one yoke oxen, and driver	do	1.60
Four-wheel ox-wagon, one yoke oxen, and driver	do	1.80
Pack donkey and driver	do	.30
Pack horse and driver	do	.60
Broken stones	per cubic metre	1.00
Pebbles	do	.70
Dressed paving stones	per square metre	2.00
Curbstone 75 centimetres long by 40 by 20	per linear metre	1.00
Rock lime	22 pounds	.05
Ground lime	per cubic metre	2.00
Hydraulic lime	per ton	4.40
Sand	per cubic metre	.60
Digging earth and throwing it an arm's length, when soil is light	do	.06
When clay	do	.11
Cutting through soft rock	do	.23
Cutting through hard rock	do	.50
Rolling (including watering) done by rollers drawn by oxen	per square metre	.02
Chipping pavement	do	.06

In Messini the streets are paved with lava from Mount Etna, which is hard, durable, and not slippery when dressed. The cost of paving the main thoroughfares—Corso Vittorio Emmanuele, Corso Cavour—over which the heaviest hauling is done, is 12 francs, or $2.40 per square metre; side streets, 8.50 francs, or $1.75 per square metre.

WALLACE S. JONES.

UNITED STATES CONSULATE,
Messina, January 26, 1891.

TUSCANY.

REPORT BY CONSUL DILLER, OF FLORENCE.

STREETS OF FLORENCE.

The streets of Florence are divided into three longitudinal zones, of which one, the central, is for wheels and the two lateral for sidewalks. The central part reserved to wheels is made in a convex form, with a

center corresponding to about one forty-fifth of the chord. The material used for paving consists of first quality hard stone, in rectangular pieces, and costs 12.50 lire per square metre, including the rubble work underneath, set in ordinary lime and fluting the surface of the stone.

The two zones for sidewalks are paved with hard gray stone, consisting of one or two pieces with raised heading, 0.12 metres high, fluted at the surface, with a decline of 0.04 metre to each square metre. Said stones fixed in their place cost 7.80 lire per square metre.

The breadth of the zones is established in proportion to the breadth of the street and generally three-fifths for wheels and two fifths for sidewalks.

The maintenance of a street, made as above, costs 0.26 lire per year for each square metre.

COUNTRY ROADWAYS.

Country roads in Tuscany are divided into national, provincial, communal, and parish roads, each supported respectively by said organizations. Sometimes adjoining provinces or communes contribute to the making and maintenance of the same road. The Italian law, dated March 20, 1865, provides for the manner of constructing and care of the different classes of roads.

The breadth varies from 5 to 10 metres, according to the importance of the road and the localities placed in communication thereby. That portion reserved for vehicles is usually three-fifths of the width of the road, the remaining one-fifth on each side, when practicable, being reserved for pedestrians. For the protection of traffic as well as of foot passengers, stone pillars, round, square, or rectangular, from 2 to 3 feet in height are placed about 4 or 5 feet apart, and where the roadway is dangerous these pillars are connected by a heavy piece of timber passing through them near the top.

Roadways paved with hard stone or granite, broken small, including digging, cost about $2.30 per square metre, if made with the common stone of the locality in the same manner, about $1.30 per square meter, and the ordinary country roads not so much used, made with stone and sand with a surface of gravel, cost about 40 cents per square metre. It is proper to mention here that in many cases the roads follow the course of the streams, especially in the mountain districts, and such materials as river stone, gravel, and sand are plentiful, hence the cost is small for material.

The yearly maintenance of highways average about 4 or 5 cents per square metre. When side walls are necessary to protect the road in case of precipices or river banks, they are built of the stone found in the locality, well cemented with lime and river sand, as are also the gutters to carry off the water.

The prevailing system for the maintenance of parish roads is of an-

cient date, viz, the compulsory attendance of all males over 15 years of age to perform free labor for a few days whenever the condition of the road renders such service necessary. The same rule holds good whenever the parish authorities agree to open a new road.

ISAAC R. DILLER,
Consul.

UNITED STATES CONSULATE,
Florence, January 30, 1891.

SICILY.

REPORT BY CONSUL PUGH, OF PALERMO.

There are perhaps few countries where a description of their road construction would be attended with the same unsatisfactory and unprofitable results as in Sicily. It is true that both city streets and country roads are constructed in accordance with national regulations, but the manner of building and appliances used are of such primitive character as to make a detailed account not only uninteresting but of no practical benefit, as the cost of street and road construction in Sicily would convey but meager idea of the cost of like construction in the United States, both on account of the abundance of materials and cheapness of labor.

MATERIALS.

Sicily is so distinctively an island of rock as to make the construction of streets and roads of any other material than stone, even were it to be had, absolutely out of the question.

The rock of Sicily is of two principal species, one a limestone abounding in such high percentage of lime as that the numerous crevices and caves in the mountains, made perhaps by volcanic action, are filled with nearly pure powdered lime, which taken from such receptacles constitutes a large, important, and inexpensive factor in road construction when mixed with the rock itself, which is easily broken; the other, a soft porous rock of coral and shell formation, so soft in fact as to be susceptible of being cut from the quarries with ordinary axes. This latter, while resembling the softest and most porous sandstone, also possesses lime in such considerable quantities that the cuttings and easily crushed smaller pieces form another important element in the construction of the less important city streets, that, like country roads, are built of broken limestone with the cuttings from this soft stone spread over to obtain a smooth surface.

CITY STREETS.

On account of the abundance of limestone, as well as cheapness of labor in preparing it, the principal streets of cities are paved with solid blocks of this stone, from 18 inches to 2 feet square by 8 to 10

inches in thickness, placed on a concrete bed of broken stone, lime, and sand, the blocks being laid in mortar for the purpose of properly imbedding the stone and leveling the surface. The durability of streets thus constructed is so apparent that comment is unnecessary.

The cost of paving a street with the black stone as above mentioned is 15 lire or $3 per square metre. (A metre is 3 feet 4 inches.) The wages paid for labor is as follows: To the stonecutters, who shape and fit the blocks, per day of 11 hours, 60 cents; to ordinary laborers, same hours, 40 cents; to boys, who beside their other work, cut large portions of the stone, 30 cents.

COUNTRY ROADS.

Country roads are constructed wholly of broken stone, the crude lime above mentioned and sand, compressed with heavy cylindrical stone rollers, this admixture with the first rainfall forming a solid concrete mass.

The construction of roads in this manner is simplified and materially aided here by the fact that the substructure is solid rock, the thin stratum of soil varying only with the unevenness of the underlying rock.

With the exception of carting the larger stone, all the material used in the construction of both streets and roads is moved by hand. The broken stone and sand is carried in baskets, the soil carried from place to place in the same manner in leveling the grade, and a great portion of this is done by boys from 13 to 18 years of age.

The cost of the less important city streets and country roads paved with broken stone, spread superficially with lime, sand, and rolled as above described, is 76 cents per square metre; country roads, without the sand, 60 cents; while the wages paid per day of 11 hours is as follows: To the master workmen who have charge of grading, leveling, etc., 60 cents; to common laborers, 40 cents; to boys working at either, 24 cents; to horse and cart for transportation of unbroken rock and sand, together with the owner who must load and discharge same, $1.20.

PAYMENT FOR STREET AND ROAD CONSTRUCTION.

For the purpose of showing the sources from whence the expense of street and road construction is derived, a translation of those portions of the Italian laws bearing upon the subject are here given:

DESCRIPTION OF STREETS.

ARTICLE IX. Common streets of public use are classified into national, provincial, municipal and vicinal streets.

National streets.

ARTICLE X. National streets are:

(*a*) The long lines of roads which in their course join directly several of the principal cities of the kingdom or the latter with the nearer first-class commercial ports.

(*b*) Those joining the foregoing with the long commercial lines of neighboring states.

(*c*) Those having exclusively a military scope.

ARTICLE XI. There can not be a national road between two points of territory joined by a railroad. When railroads are opened up to public use, running in the same direction as existing national roads, the latter shall pass to the class of provincial roads at the beginning of the immediately subsquent solar year, should the opening happen within the first half of the year, and at the beginning of the following second year when it happens in the second half of the year. * * *

Provincial streets.

ARTICLE XIII. Provincial streets are:

(*a*) The streets which serve for the more direct communication between the chief place of a province and those of neighboring provinces.

(*b*) Those which lead from the chief town of a province to the chief places of the districts into which it is divided.

(*c*) Those joining the chief towns of a province or district with adjacent most important maritime ports.

(*d*) Those which are known to be of great importance to the industrial, commercial, and agricultural relations of the province.

Municipal and vicinal streets.

ARTICLE XVI. Municipal streets are:

(*a*) Those necessary to put in communication the greatest number of inhabitants of a community with the chief places of the respective districts and those of the neighboring towns. Communities separated each from the other by an elevated chain of mountain are not considered as being contiguous.

(*b*) Tho·e which are in the interior of inhabited places.

(*c*) Those which lead from the most numerously inhabited places of a community to the respective parish churches and cemeteries. * * *

(*d*) Those serving to unite together the most important parts of a community. * * *

ARTICLE XIX. All other streets not described in the foregoing category or subject to public use are vicinal, * * * and are liable to the vigilance of the municipal authorities.

ARTICLE XXII. The land of the national streets is the property of the government; that of provincial streets belongs to the provinces, and that of municipal streets appertain to the municipalities. The following are considered as parts attached to the streets. * * * The lateral ditches which solely and principally serve for the drainage of the streets, the causeways, the elevated footpaths, and the art works of any kind established along the sides, sheltering houses and those of street guardians. * * *

In the interior of cities it is considered as constituting parts of the municipal streets the squares, spaces and narrow streets contiguous thereto, and on the public lands, the habits, existing conventions, and private rights remaining in full force.

The branches of national and provincial streets within the limits of a city or town constitute part of the municipal streets, save the aid by the government or province in the expenses of preservation and betterment as per article XLI and following.

ARTICLE XXX. National streets and all structures alongside of the same to give passage to natural water flows, are constructed, adapted, and maintained at the expense of the government. * * *

ARTICLE XXXVII. The construction, systemization, and maintenance of provincial streets and the works embellishing them are made at the expense of the province in

which they are located, or of two or more provinces joined in copartnership, voluntary or obligatory, in virtue of law when such streets extend into more than one province.

ARTICLE XXXIX. For the construction, systemization, and maintenance of municipal streets, the respective municipalities provide either separately or in copartnership with other municipalities, they concurring together in the expenses according to the degree of interest of each. * * *

ARTICLE XLI. The systemization and maintenance of branches of municipal and provincial streets comprised within populous towns or cities, are to be supported by the respective municipalities under the technical surveillance of government or provincial engineers. In respect to the maintenance thereof the government or the province gives the municipality an annual indemnity equal to the expense of maintenance of a contiguous branch of street of like length in the identical condition outside the populous places. * * *

ARTICLE XLII. When the government or provincial administration thinks the total renewal necessary of a branch of national or provincial street comprised within a populous place, it, as far as the normal width of the street, supports the relative expense. * * *

(*a*) Entirely in towns having less than 1,000 inhabitants.

(*b*) One-half in towns having less than 4,000 inhabitants.

(*c*) One-fourth in towns having 4,000 inhabitants and upward.

ARTICLE LI. The reparation and maintenance of vicinal streets are supported by those who make use of them in going to their properties either if the latter are or are not contiguous to the same streets, when by right or custom such a support may not be against determinate properties or persons. The municipalities could also be held to a concurrent share in the repairing expenses of the more important vicinal streets.

COST OF MUNICIPAL STREETS.

The average cost of each kilometre of municipal street is as follows:

In plain land	$400
In hilly land	800
In mountainous land	1,600

The depth of the pavement of country roads varies from simply smoothing the surface of rock over which the roadway passes to a pavement of broken stone 6 inches in depth, and the effect of such road making upon contiguous land can not be estimated, as there is neither a market for nor sale of farming lands in Sicily.

HORACE C. PUGH,
Consul.

UNITED STATES CONSULATE,
Palermo, Italy.

HOLLAND.

ROTTERDAM AND SCHIEDAM.

REPORT BY CONSUL GARDNER.

ROTTERDAM.

The materials employed for street paving in Rotterdam are bricks of clay, bricks of scoria or slag, and blocks of limestone and porphyry. The clay bricks are manufactured in the Netherlands, along the river

de Waal; the scoria bricks by the Tees Scoria Brick Company, of Middleborough-on-Tees (England); while the limestone and porphyry come from Belgium, and are cut in blocks at the quarries.

The uniform and only paving foundation in Rotterdam is a bed of sand, carefully packed; and the thickness or depth of pavement upon this bed is as follows: Clay bricks, 4⅓ inches; scoria bricks, 5 inches; limestone and porphyry, 6 inches. "The underlying soil there, as in other Netherlands cities," says the adjunct director of public works in Rotterdam, "presents great difficulties in the way of a level pavement surface, being for the most part formed of sand and turf unevenly compressed, and affording but indifferent subfoundation for heavy traffic." Nevertheless, the pavements in Rotterdam are, despite the difficulty here cited, remarkably well maintained.

The average cost to the city for its clay-brick pavement is 62½ cents (American) per square yard; for limestone, 62½ to $1.25 per square yard; for porphyry $1.56 and for scoria brick $1.25 per square yard—all put down. The original work of paving, and the work of maintaining pavements, is at the expense of the municipality, and is done by workmen in the city's employ. The original cost of streets is at the charge of private owners only when at their option streets are opened through their own property with the view to increase valuations. In such case, the streets being properly made, are accepted by the city, and thereafter maintained at the city expense.

As to the average duration of the different varieties of pavement employed, the city officers of Rotterdam are unable to give authoritative information, and are also unable to state with accuracy the total mileage of paved streets or the proportion of each pavement in use.

The present average cost to Rotterdam (population, 210,000) for maintaining and extending its paved thoroughfares is $40,000 per year. Ten years ago the average annual cost was $32,000.

Asked, "which pavement, in view of the experience of Rotterdam, does the public works department deem to be the best and most economical for light traffic and heavy traffic, respectively?" the adjunct director replied, "for light traffic, our Netherlands brick; for medium traffic, Scoria bricks and the best kinds of limestone; for heavy traffic, paving blocks of porphyry."

Rotterdam streets, it is to be added, are built for heavy teaming; there is almost no driving for pleasure. The din of traffic over the unyielding stones is ceaseless and distracting. Rotterdam pavements are possibly the best for the needs of this always busy, always toiling city. But, on the whole, even in the judgment of many of the good people of Rotterdam, their street-pavement system is, for other cities, a very good system to avoid.

SCHIEDAM.

This city (population 26,000) employs in its street making, river sand, clay brick, and granite. The brick are of Netherlands manufacture; the granite comes (cut in blocks) from Belgian quarries. No artificial stone is used.

Upon its sand foundation the brick pavement of Schiedam is $4\frac{1}{3}$ inches depth; the granite, $5\frac{9}{10}$ inches. The former costs, put down, on the average, 58 cents (American), and the latter $1.50 per square yard. Only small side streets and the sidewalks of principal streets are brick-paved, granite being used for the roadways of all main streets.

All original work and all work of maintaining the streets is done under the authority and at the expense of the city, by city employés. The present average annual cost of street maintenance in Schiedam is $5,200.

WALTER E. GARDNER,
Consul.

UNITED STATES CONSULATE,
Rotterdam, Netherlands, January 27, 1891.

NETHERLANDS PUBLIC ROADWAYS.

[Translation of notes relating to Netherlands public roadways, furnished by the honorable secretary-general of the Netherlands department of public works.]

[Inclosure in Consul Gardner's Report.]

The general system of dikes in the Netherlands is not created and maintained at the expense of the national treasury. There are, however, some dikes thus maintained, in pursuance of early conditions, or agreements entered into with a view to the general interest, or because of the utter inability of persons or communities to protect themselves. The general rule of the Netherlands is that dikes are at the expense of those whose property is protected by the dikes.

The public roadways over the dikes are usually at the expense of the several provinces, communities, or "polders" (drained lakes) benefited. Only in certain cases are some parts of these roadways at the expense of the General Government, for the same reason as is given above for the Government maintenance of certain portions of the dikes. By royal decree, however, a network of roads is assigned to be maintained by the Government, being so arranged that unhindered communication between the different parts of the country and with adjacent countries is secured.

The materials of which these roadways in the Netherlands are constructed are: (1) natural stone; (2) bricks; (3) gravel, or broken bricks; the material employed differing according as the ordinary traffic is heavy or light. The natural stone is used and recommended for the heaviest traffic, the bricks and gravel for lighter weights.

Including a sand bed of 0.20 to 0.30 metre deep, in which the bricks or natural stones are put down, the cost per square metre for road making is as follows: Natural stone, 3 to 6 florins ($1.20 to $2.40); bricks, 1.50 to 1.75 florins (60 to 70 cents); gravel, 1 to 1.50 florins (40 to 60 cents).

The price greatly depends upon the cost of transportation of the material used; the natural stone, for example, all being brought from foreign countries, at heavy outlay for freight. The prices above quoted do not include the expense of making the sub or earthen roadway. The average depth of the road pavements, including

the roadbed, is: For natural stone roads, 0.40 to 0.50 metre; for brick roads, 0.30 to 0.40 metre; for gravel roads (without sand bed), 0.20 to 0.25 metre. In many parts of the Netherlands a sand ground is found, and in such localities no special sand bed is required; but in all other cases (gravel roads excepted) the sand bed is uniformly made.

It is provided in the constitutional law that the King [the Queen regent] shall have supervision of all matters relating to "waterstaat," thus also including the dike roadways; while the law also provides that the provincial states respectively are to be charged with the adequate supervision of all public roadways within their own limits.

The artificial roadways over the Netherlands dikes are for the most part gravel roads, the cost of construction of which has been already stated. The total length of roadways in this country maintained by the Government is 1,983.696 kilometres. This figure does not include roads running alongside of canals or over Government dikes. As to the expense for yearly maintenance see Exhibit A hereto attached, stating the cost for the last 8 years. The cost of maintenance of each kind of roadway can not be given, as such cost is not separately specified in the contracts, which are usually made for 3 years.

The influence of the steady improvement of roadways in the Netherlands upon the value of real property is not easily stated in figures, as there are many other modifying conditions. In general and naturally it can be said such influence is very important.

Finally it is to be mentioned that several principal roadways have been and still are made and maintained by the various provinces with subsidies from the Government of the Netherlands, and by various towns with subsidies granted by the provinces.

EXHIBIT A.

Cost of maintenance and improvements of the great Government roadways in the Netherlands.

[One florin, 40.2 cents, American.]

Province.	Ordinary maintenance.							
	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
	Florins.	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*
Noord Brabantz	60, 211	58, 883	59, 023	59, 013	63, 520	59, 152	57, 636	64, 285
Gelderland	155, 907	156, 780	151, 795	146, 600	147, 814	147, 877	124, 130	125, 092
Zuid Holland	85, 872	103, 859	108, 000	95, 764	89, 750	90, 154	86, 955	83, 340
Noord Holland	62, 547	60, 286	59, 456	53, 760	54, 351	53, 923	84, 434	48, 971
Zieland	25, 767	23, 329	23, 554	23, 568	20, 905	21, 897	30, 859	20, 654
Utrecht	61, 071	79, 342	68, 101	64, 848	63, 800	54, 928	54, 554	53, 951
Friesland	54, 230	54, 041	51, 969	52, 250	46, 002	42, 706	45, 160	44, 359
Overyssel	88, 246	87, 962	87, 552	94, 009	94, 009	94, 009	98, 696	88, 258
Groningen	36, 577	29, 776	33, 977	47, 247	31, 776	29, 196	16, 071	15, 587
Drenthe	18, 981	19, 939	18, 997	20, 570	20, 570	21, 900	21, 939	18, 867
Limburg	43, 585	43, 585	43, 585	43, 585	44, 386	44, 386	44, 386	43, 272

Province.	Improvements.							
	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
	Florins.	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*
Noord Brabantz	45, 057	35, 050	32, 828	21, 725	16, 814	19, 935	18, 117	1, 456
Gelderland	24, 911	21, 027	21, 748	11, 891	3, 821	814	11, 617	4, 601
Zuid Holland	20, 908	16, 993	13, 547	.....	.....	8, 860	.....	.....
Noord Holland	870	.....	.....	.....	.....	.....	.....	4, 422
Zietland	.....	650	416	553	624	161	.....	.....
Utrecht	.....	.....	.....	.....	.....	.....	.....	.....
Friesland	13, 112	548	5, 126	4, 581	5, 770	731	.....	1, 022
Overyssel	15, 647	30, 667	29, 874	18, 624	20, 246	23, 085	16, 033	27, 167
Groningen	31, 778	29, 799	17, 776	13, 619	13, 252	6, 550	1, 299	83
Drenthe	302	1, 995	3, 763	.....	.....	.....	.....	.....
Limburg	4, 187	9, 376	8, 635	10, 949	10, 398	14, 454	12, 047	7, 538

RUSSIA.

REPORT BY CONSUL-GENERAL CRAWFORD, OF ST. PETERSBURG.

The streets and roadways of Russia are in a very primitive condition, and every year some new method is introduced from abroad looking toward the betterment of streets and highways.

It is difficult to say anything definite about the price of repairing the streets in the city, because this is done at the expense of proprietors, under private contracts, which show a great variation in prices and in methods.

The roads in Russia can be divided into three distinct categories, as follows: First, the highways; second, the roads in the suburbs of the city; third, the streets in the city itself.

HIGHWAYS.

The highways are the work of the ministry of ways and communications, and are made and maintained at the expense of the Government, no special tax being levied for this purpose. Toll-bars exist only on the eastern Siberian highway, or Sibirsky Tract, by which most of the tea is imported from China into Russia, coming through the Irkoutsk custom-house. There the peasants, who make a regular business of carrying these goods to and from Russia, pay a certain tax per horse or wagon, and although this toll is very small it is more than sufficient to maintain the road in good order and the surplus goes towards making new roads in Siberia.

Each province in Russia has its own management or zemstro, which receives taxes, expends such sums of money as have been allowed, and renders full statement of the general affairs to the different ministries.

In this manner, when there is a surplus in any province it is not turned over to the Government, but is used for the public improvement of the province. Thus these provinces levy no tax for the roads, and it follows that the Government grants them certain monetary benefits.

In some parts of the Empire, in the Crimea for instance, the roads are naturally very good, but this can not be said of all the provinces, for in the provinces of Tamboff, Saratoff, Kharkow, Riaxan, Novgarod, the roads are very bad, and apart from putting wooden bridges where absolutely necessary, and posts in the ground every 10 or 15 yards to indicate that it is the highway, nothing is done for their maintenance. Horses run in 1 foot of dust in dry weather, and are up to their knees in mud during wet weather, while all communication ceases in autumn and spring, and this is the reason why all traffic or business in Russia is done in winter with sleighs.

During summer all the principal cities which have railroad communication make their supplies, and can only get rid of them in winter, and even then nature must provide them with plenty of snow and frost,

otherwise the country is in distress. Such are the circumstances which attend highways. It can therefore be said that only such highways exist in Russia which have been built by the ministry of ways and communications and which are under its supervision, and I do not know of any besides the Siberian tract and the highway, built a few years ago, from the Yalta to Symferopol, along the littoral of the Black Sea, in the province of Tauride, known as the Crimea.

SUBURBAN ROADS.

The roads in the environs of a city are maintained entirely at the expense of the town. Their maintenance is given out under contracts, a definite sum being allowed per verst, and no tax is levied for this purpose. The roads are made of crushed cobblestones, which are placed about 1 foot deep along the road and beaten into a solid mass with sand-earth by the use of a heavy roller moved by horse power. Some other roads in the suburbs are made in the same manner as those in the city, namely, of cobblestones, hammered into the ground, as near to each other as possible, the spaces left open by the shape of the stone is filled up with sand and little bits of stone, which are brushed over, and the whole is beaten down by the aid of hand-rammers. This pavement costs about $2 per square fathom.

CITY STREETS.

The third category comprises the streets and roads within the city boundary. These are maintained in good condition by the house proprietors. There are four methods employed, the most common being the use of cobblestones as above described. Then comes the wooden pavement, which is made as follows: The ground or basis is well beaten in and when level two side planks are firmly fixed in the space which is to be paved and are maintained upright by the interception of boards which are put down on the ground as a floor. This floor is well tarred, and then the wooden cubes are placed in, pinned together with nails or wooden pegs.

This system costs $3.50 per square fathom. This includes both material and hand labor.

This system has been tested in a new form as a trial. The wooden blocks were in the shape of bricks, and had been left to moisten in a certain chemical preparation, which prevents the wood from rotting; the bricks, instead of being pinned one to the other, are affixed with cement. This means was introduced for the first time last year by some French engineers, and it is said that such a street will last 3 years; although somewhat more expensive than the ordinary pavement, still, if it should prove to endure the rigorous winter frost it will be largely adopted in Russia, where the roads have to be repaired each summer.

I might say here that when Alexander Dumas, the French author, returned from Russia, which he had been visiting, he was asked how

he had found the streets and roads, to which he answered that he had scarcely seen any, inasmuch as during the winter season they were covered with snow, and during the summer they were in process of repair.

Although the above may seem an anecdote, yet it represents a truth; for as soon as spring sets in all the principal streets are put under repairs, while the less important are repaired later in the season.

Asphalt is very little used for street pavement. Only two streets of little thoroughfare are paved with asphalt, and it has proved a failure for the contractors.

Two long streets of this capital were paved two years ago with blocks of hard stone, such as the streets of Paris and London, and although this process turned out very expensive, it is hoped to be cheaper in the end, especially so if it does not require to be repaired this year.

In some of the principal streets the wooden pavement is made obligatory, and any proprietor who refuses to concede to the ruling is promptly fined, and the work done by the municipal authorities at his expense.

J. M. CRAWFORD,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
St. Petersburg, March 21, 1891.

SPAIN.

REPORT BY CONSUL TURNER, OF CADIZ.

ROMAN ROADS IN SPAIN.

Since mankind constructed society and became distributed over countries roads have been necessary. From the time of Moses there have been royal roads. First the Egyptians, afterwards the Israelites, and then the Greeks called their lines of travel that were not used for special purposes royal roads, or the king's highways. In Greece the royal roads were inspected and cared for by the Senate at Athens. In Lacedemonia, Thebes, and other states they were under the supervision of the most eminent men. Their roads, however, were not the best of the ancients. It was reserved for a commercial city, Carthage, to build the first paved roads.

The Romans followed the example of the Carthaginians, and their great highways, which connected Rome with its provinces were the most renowned and durable ever constructed. All over Europe, Asia, and Africa, wherever their emperors ruled, they built roads that have been supposed, by the vulgar of different ages, to have been of supernatural origin. This is attested by the names applied to them in Italy, England, France, and Spain. In the last mentioned they have been known by such appellations as Calzada del diablo (road of the devil), Calzada de las gigantes (road of the giants), etc.

According to St. Isidoro, the first paved roads of Spain were built by

the Carthaginians, and the same authority states that the Phœnicians opened (and left to their successors) a road across the Pyrenees and the Alps many centuries before the Christain era.

The most ancient Roman road outside of Italy was in Spain, and led from Cartagena to the Pyrenees, where it connected with others that led across the Alps to Rome. This road was traveled by the legions of Scipio the Less. The reign of Augustus is renowned for the roads then completed. This emperor made the system of communication so complete that little else was left for his successors to do than to care for the roads already constructed. Of his successors Trajanus was the most zealous, as is shown by various inscriptions found in Spain, in preserving the public highways and in constructing others. His example was followed by Adrian, Lucius, and others, but afterwards the authority of the emperors decayed and little care was given to distant public works. The removal of the court to Byzantine by Constantine completed the abandonment of road building, and was the beginning of the ruin of that magnificent system of highways that laced Rome to its most distant provinces. The Romans divided their roads into military highways, called also consular or pretorian thoroughfares, and local *vias.* The first were built to facilitate the marching of armies and to connect the capital with the principal cities and strategic points. They were constructed and kept in repair by the imperial government. The second were the routes of commerce and connected towns and trade centers, and were constructed to facilitate the relations and intercourse of traffic. They were built and maintained by municipal governments.

These highways were pavements firmly and simply leveled, and of such solidity that remnants of those of the first class are still found in a state of fair preservation in various countries. They were generally narrow, being from 4 to 6 meters in width, and constructed as follows:

The road-bed was excavated, and in it was first placed a layer of stones. The stones of this bottom layer were sometimes united with mortar. Over it was placed a strata of plaster made of stone or brick pounded with mortar. This was followed by another of sand and lime or sand and earthenware clay, which, like its predecessors, was pounded and leveled with great force. The top was made of irregular stones united with cement. The road formed a pronounced curve between strongly made curbs, which at regular distances were elevated to serve as stiles for the mounting and dismounting of horses. All roads were supplied with mile-posts, the Roman mile being approximately equal to $1\frac{1}{2}$ kilometers.

At a distance of about 30 miles apart on the principal routes the Romans established a series of stations called *mansiones.* Each of these *mansiones* was supplied with 40 horses and carts, oxen and pack-mules necessary for the transportation of baggage and other effects. Mid way between the *mansiones* were smaller stations called *mutationes,* where only 20 horses, etc., were kept. An ancient document, said to be the Itinerary of Antoninus Augustus Caracalla, shows the total

number of imperial or military highways to be 372, of which only 34 belonged to the province of Hispania, which is to-day known as Spain and Portugal. The total mileage of these 34 roads was 6,926. According to Coello, who collected data relating to the Roman roads of Spain, there were 20,000 miles constructed. He, of course, includes commercial routes, of which the itinerary referred to makes no mention. These roads were undoubtedly numerous. They are often referred to in the writings of Pliny and other historians.

Although the Itinerary of Antoninus Augustus Caracalla can not be accepted as a complete plan of the military roads of Rome, it is certain that it includes the most important, and is very useful in the study of Roman highways. For that reason I herewith present that part of it which refers to the Roman roads of Spain.

It shows the Roman names of the *mansiones* and the modern names by which their ancient sites are known to-day. The mileage is also shown.

Roman roads of Spain according to the itinerary of Antonino Augusto Caracalla.

1. ROAD FROM ITALY TO SPAIN AND PORTUGAL.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Summo Pyreneo	Coll de Pertus	
Deciana	Junguera	16
Juncaria	Figueras	12
Cinniana		
Gerunda	Gerona	27
Aquis voconis	Caldes de Malavella	
Secoras	Hostalrich	
Praetorio	Llinás	
Semproniana	La Roca	
Arragone		
Barcinone	Barcelona	22
Fines	Cerca del Castillo de Gélida	
Antistiana	Junto á Moryos	
Stabulo novo	Castellnou	
Palfuriana	Alo del arco de Barà	
Tarragone	Tarragona	24
Ad septimum decimum	Vilavert	
Ad novas	Vinaixa	
Ilerda	Lerida	
Mendiculcia	Cerca de Algayon	
Tolous	Monzon	32
Caum		
Pertusa	Pertusa	18
Osca	Huesca	19
Bortinæ	Llano de Violada	
Gallicum	Cerca de Zucra	
Cæsar Augusta	Zaragoza	
Allobone	Alagon	
Balsione	Cerca de Mallen	
Cascanto	Cascante	
Gracurris	Cerca de Corella	
Calagurra	Calahorra	29
Barbariana	Junto à Agoncillo	
Vercla	Varea, cerca de Logrono	28
Tritio	Rodilla	18
Antiliana	La Tunta	
Libia	Cerca de Leiba	18
Segasamunclo	Cerezo de Rio Tiron	7
Verovesca	Bribiesca	11
Tritium	Rodilla	
Deobrigula	Rabé de las Calzadas	
Segisamone	Sasamon	
Dessobriga	Cerca de Osorno	
Lacobriga	Cerca de Carrion de los Condes	30
Viminacio	Despoblado de Pozanova	
Camala	Inmediaciones de Sahagun	24
Palantia	Hacia Reliegos	3
Lance	Cerro de Lancia	29
Ad Legionem vii Geminam	Leon	9

Roman roads of Spain according to the itinerary of Antonino Augusto Caracalla—Cont'd.

2. ROAD FROM ITALY TO SPAIN AND PORTUGAL VIA NARBONA.*

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Tarracona	Tarragona	.....
Oleastrum	Cerca de Hospitalet	21
Subsalter	Coll de Balaguer	.....
Tria capita	Percelló	23
Dertosa	Tortosa	17
Intibili	Cerca de la Jana	27
Ildum	Cabanes	24
Ad noulas	Onda	.....
Sebelaci	Bechi	24
Sagunteum	Sagunto	22
Valentia	Valencia	16
Sucronem	Alcira	20
Sactabi	Jatiba	.....
Ad statuas	Parluta del Toy	22
Ad turres	Mojente	9
Adello	Villena	24
Aspi	Aspe	24
Ilici	Elche	24
Thiar	Zeneta	27
Carthagine Spartaria	Cartagena	25
Eliocroca	Lorca	48
Ad morum	Navas de San Juan	24
Basti	Baza	26
Acci	Guadix	25
Acatucci	Cerca de Iznalloz	28
Viniolis	Cortijada de los Albunicles	24
Mentesa Castia	La Guardia	20
Castulone	Cazlona	25

3. ROAD FROM CORDOBA TO CASTULO.

Corduba	Cordoba	.....
Calpurniana	Canete de las Torres	25
Urgaone	Arjona	20
Iliturgis	Cuenas de Lituergo	24
Castulone	Cazlona	20

4. ANOTHER ROAD FROM CORDOBA TO CASTULO.

Corduba	Cordoba	.....
Ad decumo	.....	.....
Adlucos	Cerca de Montoro	3
Epora	Montoro	28
Uciense	Marmolejo	18
Castulone	Cazlona	32

5. ROAD FROM CASTULO TO MALAGA.

Castulone	Cozlona	.....
Tugia	Despoblado de Toya	35
Traxinum	Near to Hinojares	16
Acci	Guadix	32
Alba	Despoblado de Albizu	32
Hactara	Huéhares	24
Virgo	Campo de Dalias	34
Turaniana	Turon	16
Murgi	Near to Polapos	12
Saxetanum	Puerto de Almunecar	38
Caviclum	Cerca de la Torre de Calaturcos	16
Menova	Bizmiliana	34
Malaca	Malaga	12

*The same road as No. 1 as far as Tarragona.

Roman roads of Spain according to the itinerary of Antonio Augus to Caracalla--Cont'd.

6. ROAD FROM MALAGA TO CADIZ.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Malaca	Malaga	21
Suel	Valdesuel	.....
Cilmana	Torre de las Bóvedas	24
Barbariana	Venta de guadiaro	34
Calpe cartiam	Torre de Cartagena	10
Portu Albo	Algeciras	6
Mellaria	Near to Tarifa	12
Bellone claudia	Despoblado de Bolonia	6
Besippone	Cerca de Barbate	12
Mergablo	Conil	16
Adherculem	Castillo de Sancti Petri	12
Gades	Cadiz	12

7. ROAD FROM CADIZ TO CORDOBA.

Gades	Cadiz	.....
Adpontem	Puento de Zuazo	12
Adportum	Puerto de Santa Maria	14
Asta	Despoblado de Mesa de Asta	16
Ugia	Cabezas de San Juan	27
Orippo	Torre de los Herberos	24
Hispali	Sevilla	9
Basilippo	Cerro del Cincho	21
Carula	Puebla de Cazalla	24
Ilipa	Cerro de Repla	18
Ostippo	Despoblado de Teba la Viceja	14
Barba	Cerca de la Pizarra	20
Anticaria	Antegucra	.....
Angellas	Castil Azul	24
Ipagro	Dehesa de los Moriles	20
Ulia	Montermayor	10
Corduba	Cordoba	18

8. ROAD FROM SEVILLA TO CORDOBA.

Hispali	Sevilla	.....
Carmone	Carmona	.....
Obocula	La Moncloa	42
Astigi	Ecja	16
Addras	Venta de Siste Torres	12
Corduba	Cordoba	24

9. ROAD FROM SEVILLA TO SANTA PONCE.

Hispali	Sevilla	.....
Italica	Santa Ponce	6

10. ROAD FROM SEVILLA TO MÉRIDA.*

Celti	Aldea de las Navas	27
Regiana	Regna	44
Perciana	Villa Franca de los Barros	44
Emerita	Merida	27

11. ROAD FROM CORDOBA TO EMERITA.

Corduba	Cordoba	27
Mellaria	Cerro del Castello	52
Artigi	Despoblado de Argallen	36
Mettellinum	Medellin	32
Emerita	Merida	24

*It is the same road as No. 8 as far as Astigi.

Roman roads of Spain according to the itinerary of Antonino Augusto Caracalla—Cont'd.

12. ROAD FROM OBISPO TO EMERITA.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Olisipone	Lisboa	.....
Equabona	Coina	12
Catobriga	Setúbal	12
Cacciliana	Cerca de Agualoa	8
Malateca	Near to Marateca	16
Salacia	Alcacer-do-Sal	12
Ebora	Ebora	44
Ad-Adrum Flumen	Alandroal	29
Dipone	Near to Elvas	12
Evandriana	Near to Badajoz	17
Emerita	Merida	9

13. ROAD FROM SALACIA TO OSSONOBA.

Salcia	Alcacer-do-Sal	.....
Aranni	Between Aljustrel and Castroverde	.....
Ossonoba	Faro	16

14. ROAD FROM OLISIPO TO EMERITA.*

Olisipone	Lisboa	.....
Aritio Praetorio	Cerca de Salvatierra	38
Abeltiero	To the east of Almeyrim	28
Malusaro	Ponte de Sor	23
Ad Septem Aras	Near Albuquerque	8
Budua	Nuestra Señora de Botoa	12
Plapiaria	Dispoblado de la Matañza	8
Emerita	Merida	30

15. ANOTHER ROAD FROM OLISIPO TO EMERITA.

Olisipone	Lisboa	.....
Jerabriga	Villafranca de Jira	30
Scalabin	Santarem	32
Tubucci	A league from Abrantes	32
Fraxinum	Between Gafete and Castelho da Vide	32
Mundobriga	Ruinas de San Anton	30
Ad Septem Aras	Near Albuquerque	14
Plageraria	Despoblado de la Matañza	20
Emerita	Merida	30

16. ROAD FROM OLISIPO TO BRACARA AUGUSTA.

Olisipone	Lisboa	.....
Jerabriga	Villafranca de Jira	39
Scalabin	Santaréem	33
Sellium	To the east of Thomar	32
Conembriga	Condeixa Velha	34
Aeminio	Counbra	10
Talabriga	.....	40
Langobriga	Towards Cortegaza	28
Catem	Villanueva de Caia	13
Bracara	Braga	35

17. ROAD FROM BRACARA TO ASTURICA.

Bracara	Braga	.....
Salacia	Asella	20
Praesidio	Gralhas	36
Caladuno	.....	16
Ad Aquas	Chaves	18
Pinetum	Pentes	20
Roboretum	Ruinas de Valdetelelhas	35
Complentica	Castrelo	29
Veniatia	Vime	25
Petavonium	Despoblado de Sansueña	28
Argentiolum	Near Distriana	15
Asturica	Astorga	14

* Dierent from No. 12.

Roman roads of Spain according to the itinerary of Antonio Augusto Caracalla—Cont'd.

18. ANOTHER ROAD FROM BRACARA TO ASTURICA.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Bracara	Braga	.....
Salamana	Travassos	21
Aquis Originis	Rio Caldo	18
Aquis Querquennis	Baños de Bande	14
Geninas	Castillo de Sandias	16
Salentibus	Tióira	13
Praesidio	Castro Caldeilas	18
Nemitobriga	Puente Navrea	13
Foro	Close to Rua	19
Genestario	Near Gestoso	18
Bergido	Ruinas del Biargo	13
Intesamnio Flavis	Onamiol	20
Asturica	Astorga	30

19. ANOTHER ROAD FROM BRACARA TO ASTURICA.

Bracara	Braga	.....
Limia	Puente del Limia	19
Tude	Tuy	19
Burbida	Borbeu	16
Turogua	Ruinas close to Turon	16
Aquis celenis	Caamiña	24
Tria	Santa Maria de Tria	12
Asseconia	Quion	23
Brevis	Mellid	12
Martaie	Puente de Meryaboy	20
Luco Augusti	Lugo	13
Timalino	To the east of Baralla	22
Ponte Neviae	Nagales	12
Ultaris	Ruinas del Bierzo	16
Bergido	.....	20
Tuteramuco	Onanial	20
Asturica	Astorga	30

20. ROAD BY THE COAST OF BRACARA TO ASTURICA.

Bracara	Braga	.....
Aquis celenis	Caldas de Reses	*165
Vico Spacorum	Vigo	.....
Adduos pontes	Pontevedra	*150
Grandimiro	Dimo	*180
Trigundo	Puente Sigusiro	24
Brigantium	Betanzas	30
Caranico	La Grana	23
Luco Augusti	Lugo	24

21. ROAD FROM ESCERI TO PAX TULIA.

Esuri	Castromarin	.....
Balsa	Near Tavira	24
Ossanoba †	Faro	16
Serpa	Serpa	13
Fines	Near Pamogo	20
Arucci	Aroche	25
Pace iulia	Beja	36

* Stadia.

† From here continues the road No. 13 as far as Salacia, and according to the road No. 12 to Ebora.

Roman roads of Spain according to the itinerary of Antonino Augusto Caracalla—Cont'd.

22. ROAD FROM ESURI TO CASTROMARIN.

Ancient name of mansions.	Present names of ancient sites of mansions.	Miles.
Myrtili	Mertola	40
Pace iulia	Beja	36

23. ROAD FROM OSTIA FLUMINIS ANÆ AYAMONTE.

Præsidio	Villanueva de los Castillejos	24
Ad rubras	Cabezas rubias	28
Onoba	Huelva	28
Ilipla	Niebla	30
Tucci	Ruinas de Tejada	22
Italica	Santiponce	18
Monte Mariorum	Puerto Moral	46
Curiga	To the south of Monasterio	49
Contributa	Between Medina de las Torres and Calzadilla	24
Perceiana	Villafranca de los Barros	20
Emerita	Merida	24

24. ROAD FROM EMERITA TO CÆSAR AUGUSTA.

Emerita	Merida	.....
Ad sorores	Baldio de Santiago	26
Castris cæcili	Caceres	20
Turmulos	Ventas de Alconetar	20
Rusticiana	Near Riobolos	22
Capara	Venta de Caparra	22
Cascilio Vico	Puerto Bejar	22
Ad lippos	Near Valdelascasas	12
Sentice	Frades	12
Salmantice	Salamanca	24
Sabariam	Torre del Sabre	21
Ocelo Durí	Zamora	21
Albocela	Toro	22
Amallobriga	Despoblado de Aronillas	22
Septimanea	Simancas	14
Nivaria	Despoblado de Cardiel	12
Cauca	Coca	22
Segovia	Segovia	29
Miacum	Despoblado de los Meagues	29
Titulciam	Bayona de Titulcia	24
Complutum	San Juan del Viso, near Alcala de Henares	30
Arriaca	Guadalajara	22
Cæsada	Despablado de Monte	24
Segontia	Sigüenza	23
Arcobriga	Arcos de Medinaceli	27
Aquæ Bilbitanorum	Alhama de Aragon	16
Bilbili	Calatayua	24
Nertobriga	Calatoras	21
Segontia	Near Peraman	14
Cæsar Augusta	Zaragoza	16

25. ANOTHER ROAD FROM EMERITA TO CÆSAR AUGUSTA.

Emerita	Merida	.....
Lacipea	Villavieja	20
Leuciana	Valdecaballeros	24
Augustobriga	.....	22
Toletum	Toledo	55
Titulciam*	Bayona de Titulcia	24

26. ROAD FROM ASTURICA TO CÆSAR AUGUSTA.

Asturica	Astorga	.....
Bedunia	San Martin de Torres	20
Brigeco	Villabrazaro	20
Vico Aguario	Despoblado de Castro-Torafe	27
Ocelo durí	Zamora	14

* From here the road No. 24 continues to Cæsar Augusta.

Roman roads of Spain according to the itinerary of Antonio Augusto Caracalla—Cont'd

27. ANOTHER ROAD FROM ASTURICA TO CÆSAR AUGUSTA.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Asturica	Astorga	.....
Brigeco	Villabrazaro	40
Intercantia	Villanueva del Campo	20
Tela	Near Gaton	22
Pallantia	Palencia	.....
Pintian	Alto de las Pinzas	24
Raudam	Roa	40
Cluniam	Coruña del Conde	26
Uxamam	Osma	24
Voluce	Calatañazor	25
Numantia	Garray, near Soria	25
Augustobriga	Muro de Agreda	23
Turiasone	Tarazona	17
Caravi	Near Magallon	18
Cæsar Augusta	Zaragoza	37

28. ROAD FROM TURIASO TO CÆSAR AUGUSTA.

Turiasone	Tarazona	.....
Balsione	Near Mallen	20

29. ROAD OF EMERITA TO CÆSAR AUGUSTA BY LUSITANIA.

Emerita	Merida	.....
Metellinum	Medellin	.....
Contosolia	Magacela	15
Mirobriga	Capilla	36
Sisapone	Almaden	13
Curcuvium	Caracuel	20
Oretum	Nuestra Señora de Oreto	.....
Ad Turres	Nuestra Señora de las Virtudes	26
Mariana	Nuestra Señora de Mariena	24
Ramini	Cerro de la Mesa	30
Alces	Near Miguel Esteban	40
Vico Cuminario	Despablado de Dancos	24
Titulciam	Bayona de Titulcia	18

30. ROAD FROM LAMINIUM TO TOLETUM.

Laminio	Cerra de la Mesa	.....
Murum	Despablado, two leagues from Villaharta	27
Consabro	Consuegra	23
Teletum	Toledo	44

31. ROAD FROM LAMINIUM TO CÆSAR AUGUSTA.

Laminio	Cerro de la Mesa	.....
Caput fluminis anæ	Nacimiento del Guadiana	7
Labisosia	Lezuza	14
Parietinis	Pærazos Viejos	22
Saltici	Chinchilla	16
Ad putea or Ad pullem	Nuestra Señorá de Belen	32
Valebonga	Valbona	40
Urbiaca	Concud	20
Albonica	Despoblado de Gallel	25
Agiria	Near Villafranca	6
Caræ	Villacadima	10
Sermone	Luco	14
Bilbilis	Calatayud	.....

32. ROAD FROM ASTURICA TO TARRACO.

Asturica	Astorga	.....
Vallata	Valladangos	16
Interamnio	Near Antimio	13
Palantia	Near Reliegos	14

Roman roads of Spain according to the itinerary of Antonino Augusto Caracalla—Cont'd.

33. ROAD FROM CÆSAR AUGUSTA TO BENEARNEEM.

Ancient name of mansions.	Present name of ancient sites of mansions.	Miles.
Cæsar Augusta	Zaragoza	.....
Foro gallorum	Gurrea del Gallego	30
Ebellino	Lliná's del Marcuello	22
Tacca	Taca	24
Summo Pyreneo	Puerto de Canfran	.....

34. ROAD FROM HISPANIA TO AGUITANIA.

Vindeleia	Santa Maria de Bivarredonda	12
Deobriga	Puentelarrá	14
Beleia	Near Estavillo	15
Suissatio	Zuazo	13
Tullonio	Towards Ascarza	7
Alba	Salvatierra	12
Araceli	Arbizeó	21
Alantone	.....	16
Pompelone	Pamplona	8
Torisa	Towards Espinal	22
Summo Pyreneo	Puerto de Roncesvalles	8

ROAD MAKING IN SPAIN.

General plan.—Roads are of three classes. Those of the first being 8; those of the second 7, and those of the third 6 metres in width.

Roads of the first order are the most useful and important. They are generally the thoroughfares that connect Madrid with the capitals of the provinces, the departments of the navy, and the principal ports of the kingdom; the branches that lead to some of these points from a railroad or a highway of the first order, those which join two or more railroads passing by a city of not less than 15,000 inhabitants, and those which unite two or more highways of the first order, passing by some capital or center of population or traffic, either of the interior or coast, provided it exceeds 20,000 inhabitants.

Roads of the second order are those which place two provincial capitals in communication, those which connect a railroad with a highway of the first order, those which starting from a railroad or a highway of the first class terminates in a head town (a town that is not under the jurisdiction of another) or one that has a population of more than 10,000 and those which in the Balearic Islands put the capital in communication with other seaport towns or unite points of production and exportation.

Roads of the third order are those which do not come under any of the foregoing definitions. Roads of the third order are generally useful to one or two towns only.

Plans and specifications of a road determine its route, longitudinal and transversal outlines, cubical movement of earth, etc., gives a

description of the work and estimate of its cost, and states whether it is to be built of the ground and material adjacent to the road or of material to be brought from a distance.

Direction or route of a highway or the points it is to serve are always based upon political commercial or strategic considerations and reduces the problem to a search for the most available route between the determined points. If there be no impediment it is clearly understood that the most direct should be selected, but sometimes on account of the ownership of certain lands being vested in influential parties, ecclesiastical or civil corporations, and for many other reasons arising from the topography of the country between the given points it has been found convenient in Spain to make indirect and curved roads. It has also been customary to follow the bed of streams, such routes offering the lines of least resistance.

Grades, etc. The upward slope of a Spanish road must not exceed 5 centimetres to the metre. The water shed or transversal slopes must not rise to exceed 2 centimetres to the metre. At the sides of each road are paths that are used by the road overseers for places to deposit material for repairs. These paths are also used by footmen and as places for the erection of posts, etc. The outside margins of these paths terminate in gutters, into which the lateral slopes of the road are expected to precipitate dust and rain. Suburban roads are sometimes paved with granite blocks and asphalt, or with a concrete of broken stones, lime, sand, gravel, and clay, but it is seldom that a country road is constructed of any other material than that of the adjoining land.

HISTORY OF ROAD BUILDING.

Highways, such as are known to the present age, did not exist in Spain before the middle of the eighteenth century. Before this date Spanish roads were simply paths. Reforms were inaugurated, but in almost every case by private individuals, who, encountering more or less difficulty, built bridges across the principal rivers. The foregoing does not mean that there were no roads in Spain during the middle age, for there are documents which show that some attention was paid to road building, but it is impossible to unite such documents and ascertain clearly the extent of such undertakings, neither can they be compared with what has since been done.

In 1749 Fernando VI constructed the highway from Reinoso to Santander, and some pieces of the Guadarrama, employing soldiers for the work. To this and to the building of some roads in the Vascongada and Navarra provinces is limited all that was done in 12 years in this branch of public work.

In 1761 the government first commenced to fix its attention upon the subject and to dictate regulations for the classification, construction, and conservation of general highways, paying particular attention to the roads from Madrid to the royal resorts, and from Madrid to Barcelona.

The dispositions of 1761 and the modifications of 1778 were unsuccessful, and no real advancement was made.

In 1794 the supervision and building of public roads was delegated to a special bureau of the government. But this, too, proved unsatisfactory on account of a lack of road-building intelligence in the personnel of the bureau. The only good roads of that time were built under the direction of foreign engineers, or of the Spanish military engineers, whose knowledge of such undertakings was vastly superior to that of the bureau that the state intrusted with the work.

Up to this time, right ideas as to permanent estimates of expenditures for preserving and constructing roads, and as to material, etc., were not dominant. This will be readily understood when it is known that at the end of the past century there were in Spain only 2,000 kilometres of road, in a fearful state of conservation, and 605 bridges to show as the results of over 50 years of endeavor.

Nothing better can be said of the present century until the year 1834. But it is just to say that now progress of a substantial character is being made. The wars that have received the energies and treasure of the country explain the fact that up to the year above cited the sum total of highways had reached but 4,700 kilometres, and they were in a wretched state of preservation.

In 1833 a bureau of roads, highways and canals was created, and a special school established for the education of civil engineers. This school graduated its first corps of engineers in 1839. At the end of the first Carlist war, attention was again aroused upon the bettering and repairing of public highways, and some repairing was done, and a few new roads commenced from Madrid to the coasts and frontier. Development was, however, very slow, because even though the state had good plans and intentions, they could not be executed because of the bad state of the treasury. The bureau struggled against these difficulties, and at the opportune moment was able to dictate amendments to the existing law. Thus in 1842 a law was adopted which brought into existence a national corps of roadbuilders. They are called *peones camineros*, and are classified and uniformed, and are employed by the state in building and repairing roads. They constitute a distinct branch of the public service. This change was important, and soon placed experienced workmen under intelligent direction.

From 1834 to 1856 4,800 kilometres of road were completed, and 3,000 more projected.

At the present time, according to the latest data (1888), the length of the completed public roads of Spain is as follows:

	Kilometres.
First order	6,873
Second order	8,338
Third order	11,097
Total	26,308

The kilometre equals 0.621376 of a mile.

In addition to the above amount there are 31,000 kilometres projected. I mean by this that no work has been done on the 31,000 kilometres, but that part of the legal preliminary steps have been taken to establish additional roads aggregating that length.

GENERAL ROAD SYSTEM.

Roads of the first, second, and third order form what is called the general system.

Modifications of the general system.—To introduce a road into this system it is necessary to draft a memorial outlining the proposed route. This is submitted to the city councils along the proposed line, to the provincial assembly, to the council of agricultural industry and commerce, to the chief engineer of the province, and to the civil governor of the province, who forwards it to the ministro de fomento, who consults with the council of roads, canals, and ports and determines whether the proposition to include the road in the general system shall be submitted to the Cortes. This minister determines whether the road shall be assigned to the first, second, or third order.

The above is also the mode of procedure when it is desired to vacate some road or part of a road included in the general system.

Formation of plans.—It is the duty of the ministro de fomento to propose plans within the legislative credits provided for making roads, always confining such propositions to highways of the general system. The approbation of all plans for highways belongs to this officer, who, upon information derived from the chief engineer of the province and the council of roads, canals, and ports, drafts the royal order of approval. After the approval of a plan it can only be modified by going through anew the process of formation.

Construction and repairing.—No road can be constructed until it has been classified and its plan approved by the ministro de fomento.

Each year the amount to be spent upon public roads is fixed and a specified sum designated for each class. In this way a harmonious development of the system is intended. In arranging expenditures preference is given to roads that have been left in an unfinished state.

The building of roads is let by contract to private corporations or individuals, or performed under the direction of the engineer corps of the council of roads, canals, and ports. If let to contractors the interests of the Government are guarded by a commission selected by this council.

The Government can impose separate taxes and tolls on roads for repairs and construction.

PROVINCIAL ROADS.

The provinces also have their system of roads. The board of public works of each province forms and presents to the diputacion (provincial assembly) a plan which includes all the highways that are of in-

terest to the province and determines the order of construction and improvement. This plan is placed before the public from 30 to 60 days, with all its details, for examination. During this time it is examined and discussed by the city councils of the province and by interested citizens. At the end of the time specified the diputacion examines the observations of the board of public works, of those of the provincial council of agriculture, industry, and commerce, and to those of the chief engineer of the province, and decides what shall be included in the system of public roads that shall be requested of the department of fomento. When this is done the civil governor of the province forwards the plan of the diputacion, with a proper memorial, to the ministro de fomento, who, after consulting the council of roads, canals, and ports, decides definitely what shall be granted. If he is favorable to the plan admitted, it is immediately announced by royal decree.

The same procedure is followed in adding to a system of provincial roads or in vacating them in whole or in part. If the plans do not affect the public domain, the approval of the diputacion is sufficient, otherwise they must also be approved by the civil governor. In either case the chief engineer of the province is consulted, and if there should be a disagreement it is adjusted by the ministro de fomento.

Building and repairing.—Work on a road can not be commenced until the estimated cost is provided for in the provincial budget. Repairing of roads must be paid from special funds collected for such purpose. If a road is to be paid for from the general funds of the province the submitted plans must so state.

The same rules, as to contractors, prevail in the province as in the state, inspection, etc., being delegated to the chief engineer of the province and officers of the board of public works.

The ministro de fomento can also inspect the building of such roads, and if not satisfied must communicate at once with the diputacion of the province, which must take immediate steps to remedy the defects cited. If the diputacion refuses to act, then the civil engineer of the province, in conjunction with the civil governor, must see that the work conforms to the requirements of the departmento de fomento. When a road is completed it must be accepted by the chief engineer of the province before it is used by the public. This is indispensable, and if any dispute arises regarding the acceptance it is taken first before the civil governor, whose decision can be reviewed and set aside by the ministro de fomento.

The provincial diputacion may levy tolls and taxes on the roads of the province to create a fund for building and repairing. It is necessary, however, to first secure the consent of the ministro de fomento to such levies.

ROADS AFFECTING TWO PROVINCES.

In such cases each province prepares a plan and sends it to the ministro de fomento, and if he should not approve either plan he is authorized to decide what shall be done without more ado.

HIGHWAYS SUPPORTED BY MIXED FUNDS.

These are roads that for various reasons are built and supported jointly by the state and a province. The chief reason for these mixed funds is the necessity of the road for the welfare of the province and of its financial inability to build it without aid from the general government.

RURAL ROADS.

By royal decree of April 7, 1848, the law of May 28, 1849, and that of May 4, 1877, all roads of interest to particular towns, cities, or localities were called caminos vecinales. They are not included in the system of national or provincial highways. They are also known as caminos rurales, *i. e.*, rural roads.

The construction and conservation of these roads have at times been under the control of the general government, and at other times municipalities have supervised and built them. This responsibility has been from the beginning of the present century in harmony with the tendencies of different governments towards centralization or local self-government.

The law of July 22, 1859, scheduled these roads as highways of the third class and placed them under the control of the general government. The law of November 14, 1868, placed them again under the control of city governments, and the laws of December 29, 1876, May 4, 1877, and regulations of August 10, originated the present mixed system. By this system city councils must provide for the roads under their jurisdiction which are those that have been constructed to satisfy the needs of their locality and are not therefor a part of the national system.

In order to secure a new road of this class its plans must be drafted by the engineer of public works under the authorization of the city council. This draft is submitted to the inspection of the public and any citizen can file objections to it. In the course of time the council considers the plan together with any objections that may have been filed, after which it is sent to the civil governor of the province, accompanied by an appropriate memorial. The governor then submits the plans, etc., to the civil engineer and to the provincial assembly (diputacion), after which it is returned to him with their findings for his disposition. Should the plan not meet with his approval he must return it to the city council with his objections. If the council refuse to accept his conclusions the whole matter is by appeal brought before the ministro de fomento at Madrid for final solution. Two or more towns or cities may be interested in the construction and maintenance of a road and there may be questions as at what point the responsibility of one ends and another commences. One may desire the building of a new road and another be unwilling to share the expense, etc. In all such cases the line of procedure is the same. The city councils send plans and memorials to the civil governor who confers with the

civil engineer and with the diputacion of the province before rendering his decision, which can be received and set aside by the ministro de fomento. Cities of less than 2,000 inhabitants can not submit plans, neither can those that are without resources to execute them. Cities that are satisfied with the facilities offered them by the system of national and provincial roads can not be compelled to assist in constructing rural or local ones.

The execution of the work of building a road can be let by contract, which is sold to the lowest responsible bidder. The bids are sealed, etc. Or it can be perfor med under the direction of a civil engineer selected by the city council from among persons of known professional rank and aptitudes.

As soon as plans have been approved the council must take immediate steps to complete the work.

The city council can, by securing the consent of the ministro de hacienda, impose and collect tolls for the use of the roads under their control. Application is made for this privilege to the ministro de hacienda through the department of the ministro de fomento.

PRIVATE ROADS.

These include all roads for the use of mines and other industrial works and roads of private estates. Such roads can be opened by first obtaining the consent of the civil governor of the province. If it becomes necessary for an individual to open a private road through the estate of a neighbor, the consent of the civil governor, who condemns the property of the route selected and assesses all damages, must be obtained. All expenses of procedure, condemnation, and damage must be paid by the party who petitions for the road.

If, in the course of time, a private road becomes desirable to the pub. lic, it is condemned as a private road and purchased for public use.

CRITICISM.

The defects of the foregoing laws and regulations of Spanish road building are plain. The activity of diputacion of the province and of city councils in constructing roads is dampened by the most absurd centralization of power in the ministro de fomento. The general government puts its hand upon or intervenes in the construction of the most insignificant local road, and by a complex system for a simple branch of public work uselessly consumes the energies of local assemblies of cities and provinces in addition to killing by slow degrees the spirit of local enterprise, which, if left to itself, wo uld carry out the projects it initiates.

COST OF ROADS.

The original cost of roads depends upon the topography of the country. The material used is generally the adjacent soil.

I have not been able to secure information as to the first cost of roads, but I hazard the opinion that road-building in Spain is expensive,

for, although labor is cheap, it is a primitive kind, and in the end is more expensive than so-called high-priced labor of modern methods and implements. For instance, grading and leveling are done with material that are carried to position in small baskets balanced on the heads of laborers, who walk leisurely back and forth between the road-bed and the situation of the material. Each basket holds about three shovelfuls. Such a workman earns from 40 to 60 cents per day, but it should be remembered that the road-builder who uses modern methods and earns from $2.50 to $3 per day can easily do in from 8 to 10 hours ten times as much as the first-mentioned can in his working day of 10 or 12 hours. In extensive works the patient and slow-going donkey is substituted for the man with the basket. Each donkey is equipped with large saddle-bags made of Spanish grass, a kind of hemp. The pockets of these bags, one of which hangs on each side, are loaded with material. Forty or fifty of these animals and their attendants constitute a gang, and pass to and from the place of loading to the roadbed, sometimes with and at others without drivers. A gang or herd of donkeys and the men who load and unload them can not accomplish more in a day than could be done by a team of good horses, a revolving scraper, and 2 men.

STREET-BUILDING.

All these methods of road-building are true of street-making also. Instead of steam rollers and crushers, men level the streets with huge mauls. The annual cost of preserving the roads of Spain is about 600 pesetas per kilometre. In the province of Cadiz there are 375 kilometres, the care of which for 1890 cost 307,500 pesetas, or 820 pesetas per kilometre. In addition, the engineers and other road officials received about 37,000 pesetas in salaries and office rent.

In some of the provinces the cost of caring for the roads is as high as 1,400 pesetas, and in others as low as 400 pesetas per kilometre.

Of street-making I can say nothing that would be of interest. The cities of this part of Spain are of Moorish pattern and the streets are narrow and crooked. The systems of paving, etc., are like the sewer systems, obsolete.

Streets are named by city councils and change with the governments, as each city council desires to do honor to celebrated men by naming the streets of the city for them. Thus there are in almost every city of Spain streets called Calle Castelar, Calle Isaac Peral, Calle Sagasta, etc.

The houses are numbered, the odd numbers on one side the even on the other. The system goes no further, and streets are never numbered.

R. W. TURNER,
Consul.

UNITED STATES CONSULATE,
Cadiz, Spain, February 4, 1891.

SPAIN.

REPORT BY CONSUL BOWEN, OF BARCELONA.

COUNTRY ROADS OR HIGHWAYS IN SPAIN.

In Spain country roads or highways are either national or provincial. Those that are national are paid for by the nation, and those that are provincial are constructed under the management of provincial committees who spend not any fixed sum, during any term of years, but such sums as from time to time their work requires. Each province has a provincial committee. The national roads are equally cared for throughout Spain, and are declared, officially, to be equally good. The provincial roads, on the contrary, vary; those in the wealthier and more public-spirited provinces are equal to the national roads, while those in the poorer and more lethargic provinces are hardly worthy of comparison with anything except, perhaps, with one another. The material used is principally small, compact, hard stone, sometimes granite, sometimes limestone, and sometimes sandstone, according to the locality; and the system of construction is always that that was conceived by Macadam. The cost of construction depends on the kind of stone used, and in the distance it is drawn, but it never rises higher than 32 cents nor lower than 21 cents the square metre for an average thickness of 20 centimetres. The annual expenditure for repairs amounts to $3\frac{3}{5}$ cents the square metre. It is the opinion of all the bicyclists with whom I have talked in Spain that the roads in northern Spain are fairly good, while the roads in southern Spain are execrable. The president of one of the three bicycle clubs in this city of Barcelona assured me that Spanish roads are not to be compared with those of France or England, but that he hopes, now that the Spanish Government has a bicycle branch in its post-office department, that the roads of Spain will be made equal to any in the world; and he believes that no opposition will be made by the tax-payers, nor by those that will have to pay assessments, as the past has proven conclusively that improved roads improve the value of adjacent land, and I have no doubt that he also believes that they improve the owners by bringing them into easier and, therefore, closer communication with one another and with the rest of the world.

HERBERT W. BOWEN,
Consul.

Barcelona, Spain, December 18, 1890.

BARCELONA.

REPORT BY CONSUL BOWEN.

CITY STREETS OF BARCELONA.

The corporation of the city of Barcelona is charged with the construction and preservation of the pavements of the streets, and consequently pays the costs of new as well as of the maintenance of old streets. As a rule the owners of contiguous realty are not required to bear directly any part of the cost, but in special cases, as for instance when a new road is made for the benefit of the proprietor of a large building, or of a block of houses, the first cost is borne by individuals, but only the first cost.

The city of Barcelona is divided into two parts, of which one is the old city and the other is the new city, or "ensanche." The greater number of the streets in the old city are paved with stone, while only a few are paved with wood, asphalt, cement, cylindrical pegs, and with flags. Of the stone pavements a part were laid over 15 years ago, and consist of sandstone procured from quarries near to the city, and collocated or laid on a foundation or bed of sand from 12 to 14 centimetres deep.

They are placed at a distance of a centimetre from one another, and the intervening space is not filled with mortar or any other preparation, but with coarse sand. The pavements of stone laid since 15 years ago consist of harder stone, more or less silicious, brought from quarries distant from Barcelona and laid on a well-moistened foundation of sand 12 centimetres deep. The stones of this pavement are from 9 to 10 centimetres wide, 18 to 20 centimetres long, and 16 to 18 centimetres high. The old stone pavements cost from 15 to 16 pesetas per surface metre, while those laid during the last 15 years cost from 22 to 23 pesetas; but the difference is to be accounted for principally by the difference in the charges of transportation from the neighboring and from the distant quarries.

In the construction of wooden pavements in the old city, a plaster foundation was first laid, 15 centimetres deep, upon which were then placed blocks of the red pine of northern Europe or of the Swedish fir, 8 centimetres wide, from 18 to 20 long, and 15 high. These blocks were then cemented together with a mixture of Portland cement, fine sand, and water. To prevent the putrefaction of the blocks they were subjected to a bath of creosote and sulphate of iron. The pavements recently laid were constructed by contract with the conditions precedent that 20 years' time be given in which to pay for them, and that the cost per surface metre be from 25 to 26 pesetas, including the cost of maintenance during the 20 years.

The asphalt pavements that have been laid in the old city cost from 10 to 14 pesetas the metre, but they have proven unsatisfactory, as they were not laid with due respect to the terms of the contract.

Flag pavements have also been laid at a cost of 16 pesetas, and

although they have proven satisfactory for the use of carriages, they have not acquired general popularity.

At present several new kinds of pavement are being laid and tested. One kind is an artificial cement pavement, which consists of a hydraulic plaster from 10 to 12 centimetres thick, on which is laid a cover of Portland cement from 4 to 5 centimetres deep, mixed with coarse sand, and then rigidly rolled and compressed. The durability of this pavement is said to be great, and it is well adapted for the use of carriages and bicycles. Another kind consists of pegs that are made from the branches or trunks of the oak tree, and that are 10 centimetres long, and from 3 to 6 centimetres in diameter. These pegs are laid vertically over a layer of stone broken in pieces from 4 to 5 centimetres in size, and rigidly rolled and compressed, and covered with a coating of coarse sand from 5 to 6 centimetres thick. The spaces between the pegs are filled with sand. The cost of this kind of pavement is about 11 pesetas the surface meter.

In the new city, or "ensanche," the streets are of great length and of a width that is never less than 20 metres and that attains sometimes 30, 50, and even 60 metres. In fact they compare favorably with the very finest streets in the world. The pavements laid there are, for reaosns of economy, made from stone brought from the neighboring quarries of Montjuich. The system employed is that of macadam. As all the finest residences of Barcelona are in the "ensanche," and as it is growing rapidly in extent and beauty, doubtless the finest modern pavements will soon be demanded by the people there and substituted for the macadam pavements, which are not altogether satisfactory to those who cultivate nerves and aspire to repose of manner and speech. As a rule the streets of the entire city of Barcelona compare favorably with those of the other large cities of Spain. One million three hundred thousand pesetas are expended annually in the maintenance of old pavements, and 600,000 pesetas in the construction of new pavements, and yet the authorities are not satisfied with the work done. They recognize the fact that a civilized people should be satisfied with only the perfection of pavement.

HERBERT W. BOWEN,
Consul.

UNITED STATES CONSULATE,
Barcelona, January 10, 1891.

CARTHAGENA.

REPORT BY CONSUL MOLINA.

CITY STREETS.

Carthagena and Murcia are the only towns in this province and district in which any care is taken to improve the street pavements. It is only 16 years ago that the municipalities began paving the principal streets without any difference as to those of light and heavy traffic.

The streets in this town and in Murcia are laid with pavement blocks of gritty stone of an excellent quality from quarries near Valencia. The blocks measure 13½ inches in length by 6¾ inches in width by 6 to to 6¼ inches in depth. They are badly cut, having an exaggerated wedge form, the bottom face looking very reduced, and for this reason they can not bè laid on sand as are the well cut stone blocks in the streets of Madrid and other places. Here they are laid in mortar, *i. e.*, a mixture of clay and sand with which the joints are also filled up.

There is no sort of foundation used but the natural substratum, which is previously leveled and rammed, it being so soft that the heavy traffic streets are full of hollows shortly after they are paved.

The cost of the aforesaid blocks free and ready in Carthagena per square meter (equal to 10.76 square feet) is from $1.40 to $1.80, the cost of the labor and other materials being from 30 cents to 50 cents per square meter.

The Carthagena town corporation is, however, actually using as a trial in some of the heavy traffic streets paving stone blocks of other sorts and sizes, some imported from Belgium and made out of smelted slag from blasting furnaces, etc., and also blocks cut from limestone quarries in Mazarron, 16 miles to the west of this port.

The Belgian blocks measure 10.76 square feet for every 52 blocks, and they cost at this port $3.05.

These are laid, after the substratum is properly rammed, on sand covered with a very light mixture of one-fourth sand and remainder Portland cement.

Full cost of square metre, including labor, sand, and cement, is $4.

The footpaths or sidewalks are now built, in general, with bands or edges of square stones, and the remainder made as follows: First, a base, 2½ inches thick, of small gravel; second, on this 1½ inches of a mixture of mortar and gravel; and third and last, a finish of mortar, *i. e.*, mixture of Portland cement and sand of one-half to 2 inches thickness, which, in the shape of flag spotted stones, makes the pavement proper.

This pavement costs from 50 to 70 cents per square metre and is giving excellent results.

The maintenance, however, of the streets is very much neglected, although great sums of money are spent thereon.

HIGHWAYS.

As it happens that the principal highways are constructed and maintained by the Government and the secondary ones by the provincial deputations, the municipalities therefore only takes care of the country roads, which, as a rule, are nearly neglected to the extent that transit is almost impossible in many of them, especially in winter. Most of the country roads are made only of natural trampling, whilst in others, near the towns, the rubbish is used, and in some small stones (if they are found near the place) are thrown over the surface in both cases.

With regard to the highways constructed by the Government, the substratum is composed of, first, 4 to 6 inches of lime or silicious stones, although sometimes all stones of sufficient hardness, broken over the very spots on which they have to be laid, to a depth of not over $2\frac{3}{4}$ inches; second, another layer of stone of 2 to 4 inches in thickness on the sides by 4 to 6 inches thickness on the center of the roads. These are broken outside until the largest of the stones reaches a dimension not exceeding about $1\frac{3}{4}$ to 2 inches, and afterwards laid on the first layer; third, land mixed with very small gravel to level the roads and fill up hollows is laid over all. The whole is then compressed by rollers. This operation is aided also, when practicable, by water.

The cost is very variable, according to the quality of the stone and the distances at which they are found; but the average price can be calculated thus: Collecting 1 cubic metre of stone found loose on the "ramblas" (dry river beds) or about the fields, from 10 to 15 cents; stones cut from quarries, 25 to 30 cents per cubic metre; cartage, 1 cubic metre of stone about 3 miles, 8 to 10 cents; breaking 1 cubic metre of stone for the first layer, 20 cents; breaking 1 cubic metre of stone for the second layer, from 25 to 35 cents.

CIRILO MOLINA Y CIRO,
Consul.

UNITED STATES CONSULATE,
Carthagena, January 10, 1891.

DENIA.

REPORT BY CONSUL MALMROS.

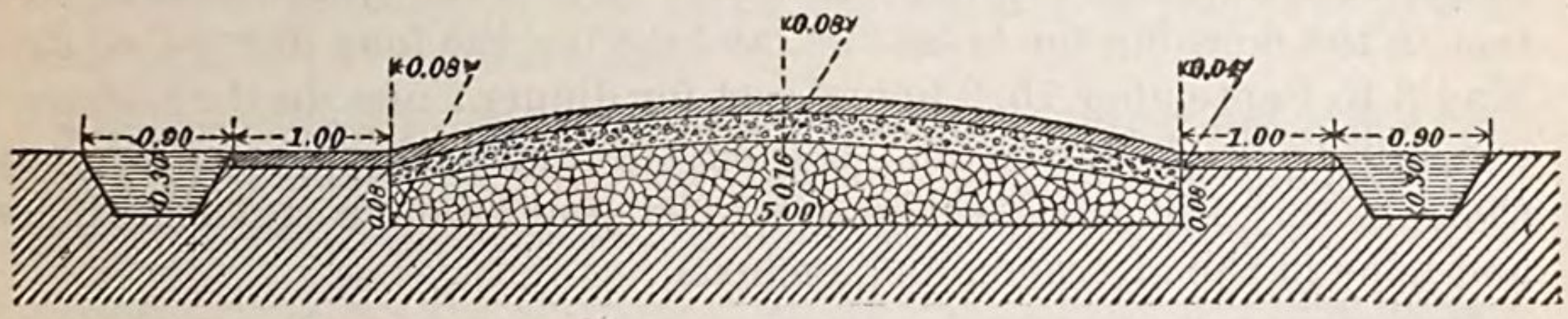
STREETS.

The streets of Denia and other towns in this consular district are common mud streets, unprovided with pavements, gutters, drainage canals or substructures of any kind, except such as unassisted nature has furnished. The only attempt made to improve the streets consists in occasionally dumping into them some cartloads of rocks of all sizes, from that of a human head to that of a walnut. The condition of the streets consequent upon this treatment is such that this kind of improvement, if such it may be called, can not be recommended as an example to be followed elsewhere.

IMPROVED COUNTRY ROADS.

A macadamized road leads from Denia to the town of Ondara, whence it branches off into three different directions. This road is 5 metres wide, with a sidewalk on each side of 1 metre wide, flanked by ditches of 0.90 metre in width.

The following plan of a cross-section of the road shows its construction and the dimensions of its several parts. It is taken from a portion of the road 1 kilometre in length, of almost perfectly level surface and possessing no features entailing extra expenses, as, for example, for bridges.



Plan of a cross-section of the road from Denia to Ondara.

After the excavation for the road has been made, as above indicated, and the ground been firmly beaten down, the first layer of stones is put on consisting of irregularly broken-up stones of from about 5 to 7 centimetres on the longest side. The second layer consists of the same kind of stones, but of smaller size, being from 3 to 5 centimetres long on the side of their greatest dimensions. These two layers are each 5 metres wide, while the third or top layer, extending as it does over the sidewalks, as well as over the road proper, is 7 metres wide. This last layer is composed of, as nearly as may be, equal parts of coarse, sandy gravel and of clayey soil. The quantity of stone and gravel required for the construction of the above-mentioned 1 kilometre of road is, from the dimensions given in the "plan," a matter of easy calculation for those interested in the subject. The stones and gravel of which this portion of the road is constructed had to be brought from an average distance of 3 kilometres. The cost of transportation of these stones and of the gravel has amounted to 1.25 pesetas per cubic metre, for each kilometre of carriage. The cost of the stone, unbroken, has likewise been 1.25 pesetas per cubic metre. The expense of breaking the stones is mentioned below in the list of wages paid. The cost of the gravel has been .37½ pesetas per cubic metre. The number of laborers employed in the building of said 1 kilometre of road has been different at different times, but the expense on account of the aggregate days' wages paid to each class of workmen has been as follows:

	Pesetas.
1,927 days' wages to common laborers, at 1.75 pesetas	3,372.25
675 days' wages to boys, at 1 peseta	675.00
1,399 days' wages to stone-breakers, at 2.25 pesetas	3,147.75
135 days' wages to heads of gangs of 10 or 12 laborers, at 2 pesetas	270.00
214 days' wages to heads of gangs of 10 or 12 laborers, more experienced, at 2.50 pesetas	535.00
117 days' wages to chainbearers and flagmen, at 3.50 pesetas	409.50
25 days' hire of roller, at 12.50 pesetas	312.50
484 days' carts' (2 horses) hire, at 8 pesetas	3,872.00
	12,594.00

The 12.50 pesetas for hire of roller above mentioned is, more properly speaking, paid for the 3 or 4 horses and for the men working the roller, for the latter belongs to the Government and has been lent free of charge.

All of the above-named different classes of laborers work, according to the custom of the country, from sunrise to sunset, having an hour's rest in the morning for breakfast, and during the long days, *i. e.*, from May 3 to September 15, 2 hours' rest for dinner; also, in the afternoon one-half hour for luncheon. During the remaining part of the year there is only 1 hour's rest for breakfast and 1 hour's rest for dinner, and none in the afternoon for luncheon.

Experience in this and adjoining provinces has shown that one laborer for each 2 kilometers of macadamized road is sufficient to keep it in perfect repair. This laborer receives a small cottage on the road in which to live, free of charges of every description, and a common laborer's wages during the days he works on the road. He has to work on all days not legal holidays whenever the weather permits work to be done in the open air. The 7 kilometers of road between Denia and Ondara, however, have to be kept in repair by a single laborer, and the consequence is that this road is in a by far worse condition than any macadamized road I have ever come across, and I have seen such roads in every European country except Portugal.

One cubic meter of broken stone is here considered all that is required to keep in good repair during the year a decametre of a road on which an average traffic is carried on. On roads of unusually heavy traffic 1½ cubic metres of stone might be required. The stone used here for macadamized roads is a fairly hard limestone. If hard granite or some other rock harder than limestone were employed the quantity necessary for repairs would of course be less. As bearing upon the question of repairs, I may mention that the wheels of the carts in which freight is transported are here considerable broader than the wheels of wagons used for such purposes in the United States, and therefore do not cut up the ground to the same extent.

The construction of macadamized roads in this part of Spain has greatly benefited commerce, but its principal effect has no doubt been the increased value of land in the farming districts through which the roads run. I have been assured by persons of undoubted competency that farms adjoining such roads have in consequence of their construction risen from 20 to 45 per cent. in market value.

OSCAR MALMROS,
Consul.

UNITED STATES CONSULATE,
Denia, June 23, 1891.

GRAO OF VALENCIA.

CITY STREETS.

The streets are paved with hewn stones (psamita micacea) 34 centimetres long, 17 centimetres broad, and 15 centimetres high, which are brought from the mountains about 15 kilometres distant from this city; the cost of these stones to hew, bring and locate them results at pesetas 9 (about $1.50) per square metre.

The soil of this city is mostly soft earth; in building the street, the soil is simply excavated to 20 centimetres depth and the stones placed directly on this ground, allowing 1 per cent. curve on the width of its superficies for the water to run off; the result of this system with a considerable traffic of carts and carriages on them is pronounced satisfactory and the cost of maintaining is 10 centimos (about 2 cents) per square metre.

COUNTRY ROADS OR HIGHWAYS.

These are generally built in this province after the Macadam method. There are roads of first and second order connecting large cities of the country and constructed by the government; roads of second and third order connecting the villages with the capital at the expense of the province, and lastly suburban roads of the fourth order built by the municipality.

The stones used for the two latter kinds of roads here are mostly limestones brought from a distance of about 4 kilometres, and cost for bringing, cutting, and locating 1.50 pesetas (about 30 cents) per square metre.

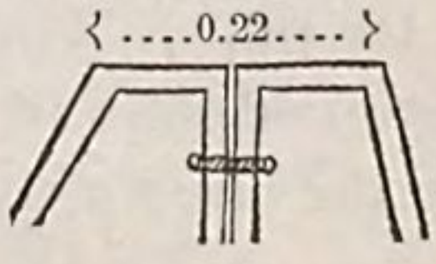
These broken up stones are placed 25 centimetres high on the road and pressed down by steam rollers.

The cost of maintaining varies according to the distance or proximity of the road to the city and the greater or lesser traffic in these different places; but, in general, the soft character of the limestone and the soft subsoil on the one side as well as the enormous traffic on the other side, this method has given little satisfaction, and new systems are constantly studied.

STEEL RAIL ROADWAY.

Mention might be made of a trial of laying a kind of flat rails, which, after a practice of 1½ years on a short distance of the road leading from the city to the port, have given excellent results, and the city has now decided to build a double track on the entire road of 3.50 kilometres, considering the uninterrupted traffic of heavily laden freight carts between the port and the city.

This track is made of ordinary steel flat-top rails of this shape, and placed without further foundation, always two together, in the soil, united with screws.



They have 22 centimetres superficie on a level with the road, but an indent of about 3 millimetres is allowed where the two rails join, for keeping the cart wheels easier on the track. The distance between the two iron tracks is 1.24 metres, roadway between which can be paved with flint stone at regular intervals. A plain steel used as cross-bar keeps the rails in their proper distance from each other. The road is 3.50 kilometres long and 12 metres wide; it will have on one side an up and on the other side a down track.

The cost of this track of imported steel rails is calculated at 50 pesetas (about $10) per running metre located and finished for use. So far the trial piece has been in use for 1½ years without any further expense for maintenance.

THEODOR MERTENS,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Grao of Valencia, December 22, 1890.

MALAGA.

REPORT BY CONSUL NEWSON.

In this section of Spain but little attention is paid to streets. Some in this city are macadamized, some are paved with syenitic blocks, a species of granite, and one street has the Nicholson pavement. The roads in the country are generally narrow, traveled mostly by donkeys, and but little cared for. The most popular mode is macadamizing. Some of these roads are very good, especially that leading to the lighthouse.

T. M. NEWSON,
Consul.

UNITED STATES CONSULATE,
Malaga, Spain, February 6, 1891.

GIBRALTAR.

REPORT BY CONSUL SPRAGUE.

There are no country roads in Gibraltar; the Rock is only 3 miles in length, its greatest breadth three-quarters of a mile, and its circumference about 7 miles.

Its acreage (including the north front, which is chiefly used for a parade ground) is about 1,266 acres, of which about 22 acres (public property) are reserved as garden ground.

By this it will be clearly seen that very little information can be obtained here likely to prove of any utility for the purposes required by the circular in question.

The streets, public thoroughfares, and walks in this British fortress, and what relates to their repairs, besides keeping them in order for general traffic, are entirely governed by the local government, who from time to time appoint sanitary commissioners to act as such, being composed of a few British officers and several members of the civil community of Gibraltar.

But few public buildings exist in Gibraltar, except military quarters and barracks, which are under the immediate supervision of the royal engineer department.

The streets and roads are somewhat inconveniently narrow and are chiefly made from limestone, which is obtained from the quarries on the north side of the rock, where the stones are broken and prepared for use as shingle before being brought into the town for macadamizing most of the roads and some of the streets, by being mixed with cement, gravel, and sand previous to being laid down, adding on some occasions, as required, granite shingle imported directly from Scotland, thereby forming with water a species of very solid concrete.

They prove to be the most handy, economical, and durable kinds of pavement for this climate, though requiring constant irrigation to lay the dust during dry weather.

Three of the principal streets, however, are paved with wooden blocks and cement, greatly facilitating general traffic, but its excessive cost prevents its more extensive adoption.

Heavy traffic is conducted by wagons and truck carts drawn by mules, and the light traffic by cabs and by means of small hand carts.

The cost of building road and street pavements is as follows:

For heavy traffic.—Wood blocks on a base of cement concrete, $5 per superficial yard; cement concrete in granite shingle, 6 inches thick on a bed of lime concrete and limestone shingle 9 inches thick, $2 per superficial yard; metaling in granite shingle (upper portion), $1 per superficial yard.

For light traffic.—Metaling in limestone shingle, 60 cents per superficial yard; pathways in cement concrete with fine limestone shingle, $1 per superficial yard.

HORATIO I. SPRAGUE,
Consul.

UNITED STATES CONSULATE,
Gibraltar, December 11, 1889.

SWITZERLAND.

REPORT BY CONSUL CATLIN, OF ZURICH.

It may with safety be stated that in no country in the world is the construction of roadways carried out with more scientific skill and thoroughness than in Switzerland. The mountainous nature of the

country, the consequent difficulty of providing means of easy communication between points located in comparative proximity to each other, and the severe tests to which roads, even when once constructed, are subjected by the violence of storms and the sudden swelling of water courses, have from the earliest period rendered the subject of road building one of primary importance to the dwellers in the Alps. It is a curious tribute to the skill and intelligence of the Romans that, in locating their Alpine roads, they followed precisely the methods recognized as best by road builders of the present time. They seldom, and then only in case of need, built a road far down on a mountain side; they followed the sunny side of the mountains, accommodated themselves to the lay of the land, and avoided great valley crossings, thus greatly diminishing the cost of the roads, and, what was to them of the greatest importance, remarkably facilitating their maintenance. Upon this plan they constructed the St. Bernhard, Simplon, Luckmanier, Bernardin, Spluegen, Septimer, and Julier roads, all of them well-known routes at the present day.

Nor were the Roman valley roads through Switzerland less judiciously laid out or less thoroughly constructed, for they coincide in the main with the leading railway or post routes of the present time. The principal ones were (1) Vevey to Solothurn to Basel; (2) Vevey to Geneva; (Gex to Payerne to Avenches, with six branches; (4) Basel to Windisch (Vindonissa) to Baden to Winterthur to Arbon (Lake of Constanz) to Bregenz; (5) Windisch to Zurzach; (6) Windisch to Solothurn, (7) Chur to Maienfeld to Vaduz to Feldkirch to Bregenz; (8) Ragaz to St. Margrethen; (9) Zurich (along the Lake of Zurich and the Wellenses) to Ragaz and over the Kunkel Pass to Reichenau.

For nearly 2,000 years these roads served as the means of international communication between France and Germany on the one hand and Italy on the other, inasmuch as up to the eighteenth century, no great changes in or additions to them had been made. During the Middle Ages the Graubuenden passes, and preferably among them the road over the Septimer, were used. The St. Gotthard Pass is first mentioned in the fourteenth century. Up to the end of the seventeenth century not one of the roads leading over the Swiss Alps was in condition to be ridden over in an unbroken journey for its entire length. In 1696 an important era in Swiss road building was ushered in by the first use of blasting powder on the roadway over the Albula Pass, but it was not until the middle of the eighteenth century that a systematic effort was begun to put the Alpine roads once more in an adequate state of repair. The rivalry of the newly developed roadway over the Mont Cenis conduced somewhat to its activity. Toward the end of the same century France turned its attention more closely to the Simplon route as well. The latter roadway was a great saving of time and distance, for it had already happened that merchandise from St. Gallen, destined for Turin, had to be sent by the long roundabout way of Geneva and Mont Cenis.

From the middle of the eighteenth century on there is also noticeable a revived interest in road building in the interior of Switzerland. In 1740 Berne inaugurated a series of fine roadways, varying from 10 to 12 metres in breadth, viz: (1) Berne to Zurich; (2) the Kystenstrasse via Burgdorf; (3) Berne to Solothurn; (4) Berne to Basel; (5) Berne to Thun; (6) the Aargauerstalden, and (7) the Muristalden. Up to the end of the last century Zurich could only point to four turnpikes worthy of the name, viz: Those leading to Schaffhausen, to Baden, to St. Gallen (via Winterthur), and to Frauenfeld. Between 1774 and 1778, Canton St. Gallen constructed her first great roadway, leading from Staad on Lake Constance, through the town of St. Gallen, to Wyl; this she followed up somewhat later by constructing the Toggenburger pike. Canton Thurgau constructed between 1776 and 1781 the first roadway from Frauenfeld (its capital) to Mazzingen, from Mazzingen to Wyl and Elgg, and from Islikon, through Frauenfeld, to Constance. Canton Basel, to which broad pikes from Germany and France gave access, continued the same onward into the interior of Switzerland in four lines, viz: (1) Along the Birs to Neufchatel; (2) over the Boetzburg to Brugg; (3) by way of Olten to Lucerne, and (4) to Solothurn and Berne. These thoroughfares were practically the only means of intercommunication in Switzerland during the better part of the last century. If they seem sparse and inadequate, it may on the other hand be stated that Switzerland was in this respect no worse off than the other European countries of that day, England not even excepted. The slowness of Europe's reawakening from the long night of the Dark Ages is perhaps nowhere more noticeable than in this regard.

But from the commencement of the present century, Switzerland has been making up for lost time. According to the estimate of Mr. S. Bavier, Swiss minister to Italy, who, in 1878, published a most interesting work entitled "Die Strassen der Schweiz," and from which the historical facts herewith given are derived, there were at that time 13,500 kilometers (8,388 miles) of turnpike roads in the country, or about 3 miles of road to every thousand of population. With justice, Mr. Bavier observes that Switzerland's network of highroads extending even to her remotest valleys, constitutes the pride and glory of the land.

The canton of Zurich is no exception to this rule. Her public highways are models in every respect, as every stranger, who has ever passed over them, whether on foot, on bicycle, or in vehicle, will readily testify. The cantonal law pertaining to the construction and maintenance of these highways gives such a clear insight into the subject that I have deemed it best to translate the greater part of it and to incorporate it herewith, viz:

LAW OF JANUARY 1, 1871, CONCERNING HIGHROADS.

I.—CLASSIFICATION OF ROADS.

(1) The public roads of the canton of Zurich shall be divided into three classes:

To the first class (turnpikes) belong those roads which serve as means of communication between the larger sections of the canton, embracing several townships, or connecting with similar roads in adjoining cantons.

To the second class (connecting roads) belong those roads which serve to connect the chief sections of a single township with each other, or with first-class roads, or with railway and steamboat stations.

To the third class (side roads) belong all those roads not embraced in the first and second classes, as well as all public footpaths.

(2) The following authorities are competent to take action with regard to classification, construction, and repairs of roads (with reserve as to Sections 5 and 6 of Art. 31 of the constitution (viz: For first class roads, the cantonal council; for second class roads, the district council, subject to the cantonal council's approval; for third class roads, the township.

Where several townships are concerned in the case of a third-class road, and no understanding can be reached, or when the minority in any township feels that its rights are infringed upon, the decision of the point in dispute rests, in the first instance, with the district council.

No decision shall be made except after a technical examination of the project, and, in the case of first and second-class roads, the wishes and views of the interested townships shall be heard.

(3) The classification of roads shall be subject to revision every 10 years.

II.—OBLIGATIONS CONCERNING THE CONSTRUCTION AND MAINTENANCE OF ROADS.

(4) The construction and maintenance of first-class roads pertain to the canton, excepting the transportation of the materials (earth not included) necessary thereto, the removal of rubbish, the clearing away of snow, the employment of assistant workmen, and the putting up of guide-posts and snow-marks, all of which services pertain to the townships.

(5) The construction and maintenance of second and third class roads pertain to the townships through whose jurisdiction they pass.

(6) The canton, however, in the case of second-class roads, undertakes, at its own expense, the preliminary technical work and superintendence of construction, and pays, in addition, a contribution to the cost of the same. This contribution (with reserve as to the exception mentioned in paragraph 8) may vary from one-sixth to one-third of the cost, and shall be fixed by the government council according to the importance of the road and the financial capacity of the townships concerned.

The canton shares in the cost of maintaining second-class roads by paying for the requisite road-keepers.

Where a township is either not traversed at all by a contemplated second-class road, or is only traversed by it to a slight extent, and yet it is to derive an actual benefit from the said road, it may be held responsible by the district council for a proportional share of the cost of its establishment in a neighboring township, with the right to appeal to the government council.

(7) The canton shall pay proportional damages to the townships in which second and third class roads are to any extent injured by the hauling of wood from the cantonel forests, or by the working of cantonel mines.

(8) In the case of first and second class roads laid out with sidewalks, pavements, gutters, etc., the excess of cost for construction and maintenance falls to the expense of the townships concerned.

(9) When the legal requirements upon any township prove, in consequence of special conditions, exceedingly burdensome, they are to be proportionally lightened by the canton.

(10) Private obligations hitherto in force with regard to the construction and maintenance of roads and bridges shall remain so, but may be commuted on demand of the parties concerned.

III.—DIRECTIONS FOR THE CONSTRUCTION AND MAINTENANCE OF ROADS.

(11) The width of driveway, with footway, shall be, for first-class roads, not less than 18 feet (5.4 metres); for second-class roads, not less than 15 feet (4.5 metres); for third-class roads, not less than 12 feet (3.6 metres). In each individual instance the width of a road shall be fixed accordingly to the requirements of the case by the competent authorities.

The area of the roadway shall, in addition to the road itself, include a width for slope, ditch, or border on each side as follows: For first-class roads, not less than 3 feet (0.9 metre); for second-class roads, not less than 2.5 feet (0.75 metre); for third-class roads, not less than 2 feet (0.6 metres). Exceptions to these rules may be made in the case of first and second class roads by the government council, and in the case of third-class roads by the district council.

(12) On straight or slightly-curved stretches of road the surface is rounded; on heavy curves there is an inward slope of at least one one-hundredth of the width.

(13) The actual roadway must, for first-class roads, be at least 15 feet (4.5 meters), and for second-class roads at least 12 feet (3.6 meters) wide, and must consist of a thick layer of stone at least 1 foot in depth. The upper stratum of this layer must be at least 3 inches (0.09 meters) deep, and shall contain no stones of over an inch and a half (0.045 meters) in diameter. Fine gravel shall be used for the footpaths on each side of the roadway.

(14) When the adjoining land does not lie at least 1 foot (0.3 meter) below the level of the border of the road, side ditches or paved borders are to be placed.

(15) Earthen slopes, at embankments, or cuts must be at least 1 foot in measurement (with an inclination of not over 45 degrees).

(16) At dangerous points the roads must be provided with fences.

(17) The boundary of the roadway must be marked out. Each two opposite stones determine its width, inclusive of ditch or border. The boundary marks are to be placed along the roads at regular distances of not over 200 feet (60 meters).

(18) Guideposts shall be erected where two or more roads unite, and when a necessity therefor exists.

(19) In order that roads may be kept in a normal condition, they shall be, whenever necessary, covered with properly prepared gravel, a sufficient supply of which shall always be kept on hand. When tracks or ruts of any kind occur they shall at once be properly leveled off. For this purpose the necessary number of gravel-boxes shall be placed along all first and second class roads, but, as far as is possible, not in the interior of towns.

(20) Dust and mud are to be collected into heaps as it becomes necessary, especiallly before gravel is laid on, and are to be removed within eight days.

(21) With a view to the proper drainage of water, the sideditches and culverts shall always be kept open and clean.

(22) For the insurance and maintenance of traffic the roads shall be provided with timely snow-marks, and, after a heavy snowfall, at once cleared.

(23) Paragraphs 11 to 14, 17, 20, 21, and 22 do not apply to public footpaths.

POLICE DIRECTIONS.

(*a*) *Relative to territory bordering upon roads.*

(24) No permanent stream of water shall, without previous permission, be conducted to a roadway from any adjoining land, building, spring, etc. The drainage, or flow of suds into road ditches or borders, or the drainage of water upon the road itself, as well as any pollution of the same by rubbish, stones, and sweepage from houses or stables, etc., is prohibited.

(25) Live hedges shall not be planted nearer to the street boundary than one-half their height, and in no case nearer than two feet (0.6 metre), and shall not be allowed to overgrow said boundway. Other (so-called "dead") fencings may be placed directly outside the road boundway. In case, however, they are closed, as for instance board fences, walls, etc., and are over 4 feet (1.2 meters) higher than the roadway, they are to be set back from the boundary line the distance by which their height exceeds such measurement.

(26) Forest trees shall be placed not nearer than 12 feet (3.6 metres) nor fruit trees nearer than 8 feet (2.4 metres) to first or second class roads, and no tree whatever shall be placed nearer than 5 feet (1.5 metres) to a third class road. Along all roads the trunks of trees are to be kept free from overhanging branches to the height of 15 feet (4.5 metres). The regulation relative to live hedges applies to bushes and ornamental shrubbery, to which latter class also belong clipped dwarf fruit-trees.

(27) New buildings and fountains must be placed at least 8 feet (2.4 metres) back from first class, and at least 5 feet (1.5 metres) back from second and third class roads, and no portion of any building shall project over the road. The law relative to the cession of private rights may be applied for removing existing buildings and fountains to the distance stated.

(28) Open water-conduits, reservoirs, and manure heaps in the vicinity of roadways shall be properly covered or inclosed, and must not be placed nearer than 4 feet (1.2 metres) to the road; likewise the unloading of manure, straw, wood, etc., within a less distance than 2 feet (0.6 metre) of the roadway is prohibited.

(29) In special cases, and particularly in those concerning the erection of rows of buildings, placing fountains, planting trees, etc., exceptions may be made by the direction of public works as for first-class roads, by the sheriff's office as for second class, and by the town council as for third class roads.

(b) Relative to road limits, and their use.

(30) A permit is required for any alteration in road limits, for filling in or covering of ditches for crossings, for placing culverts, borders, and conduit-pipes, and for the construction of the same. Such permits shall be granted by the direction of public works for first class, and by the town council for second and third class roads. A fee, to be fixed by resolution of the government council, may be charged for conducting water from private property across a road, said fee being payable to the cantonal treasury in the case of first class, and to the town treasury in the case of second and third class roads.

(31) The storing of materials of any kind on the public roads is forbidden. When the unloading of wood, stone, etc., on the road is unavoidable it must be done so as not to interfere with traffic, and the articles themselves, as well as the wagon, must be removed before nightfall. In extraordinary cases the unloading of building materials may be allowed by the town council for a period not to exceed fourteen days, subject to the regulations pertaining to the protection of traffic.

(32) Any act or contrivance jeopardizing road traffic is prohibited. The holding of markets within the road limits is only allowed in so far as it does not interfere with other traffic.

The local police is charged with the proper cleaning of the road, and with the repair of any damages thereto immediately after the close of the market.

(33) Riding and driving on the sidewalks adjoining the roadway (unless so ordered by requisite instructions to turn out), the driving of untied large cattle, the pasturing of stock along the borders of the road, the driving with fixed wheels without any wheel-shoe, the dragging of wood or stone, the use of plows too near to the side ditches or slopes, the damaging of boundary marks, railings, guide-posts, ornamental trees, etc., are prohibited. Furthermore, the leading or cleaning of plows on first or second class roads can not be permitted.

(34) No driver shall leave his draft animals untied, and none shall sit upon the wagon without having a sure rein upon them. On roads of less than 18 feet (5.4 metres) in width not more than two draft animals shall be harnessed abreast; in no case is it permissible to harness more than three abreast, or to attach two wagons together, excepting such as serve for agricultural work.

(35) Every vehicle shall turn out to the right for any other vehicle either approaching it from the opposite direction or driving up to it at a more rapid rate from behind. The driving of two vehicles abreast for any longer time than is required for one to pass is not admissible. Hand wagons are also subject to this regulation.

(36) At night every vehicle must be provided with a bell on the harness, or with a light; in the case of sleighs the former must also not be omitted in the daytime.

(37) Any vehicle or stock temporarily halted along the road shall be kept on one side so as to leave sufficient room for driving by.

(38) The width of empty wagons shall not exceed 7 feet (2.1 metres), and loads exceeding 9 feet (2.7 metres) in width can only be allowed in the case of materials the loading of which within a less breadth of space would be attended with unusual difficulty.

(39) Rapid riding or driving over bridges through narrow passages, at curves, and through inhabited towns, as well as the marching in step of a great number of persons over bridges, are prohibited.

(40) Wagons must be provided with wheels having tires of a width proportional to the largest loads admissible; two (or more) horse wagons shall not be loaded with more than 30 centners (1,500 kilograms) to each draft animal, and shall not have a less width of tire than 1 inch (0.03 metre) to each draft animal. The following are exceptions to the above rule, viz:

(*a*) Farm wagons used for carrying of goods or for harvesting crops.

(*b*) Vehicles for personal transportation or military purposes.

(*c*) Vehicles for the transportation of heavy objects which can not be taken apart, such as tree-trunks, stone blocks, pieces of iron, machinery, etc. Such vehicles must nevertheless have a width of tire of not less than 6 inches (0.18 metres).

(*c*) *Concerning public foot-paths.*

(41) The provisions of sections 24, 28, 30, 31, and 32 apply also to public foot-paths; on the other hand, sections 25, 26, and 27 may only be applied to the latter by special resolution of the competent authorities.

(42) Riding and driving on public foot-paths, as well as the driving of cattle on the same, in so far as it is not rendered necessary by unusual circumstances, are prohibited.

(*d*) *Penalties.*

(43) Disregard of the instructions contained in section IV will be regarded as trespass, and subject to a penalty of from 2 to 50 francs.

(44) Any one damaging a road is obliged to repair the damage or make compensation therefor.

(45) Owners of vehicles or driver of cattle are responsible for trespasses or damages caused by persons in their employ.

V.—SUPERINTENDENCE AND ENFORCEMENT.

(46) The chief superintendence of all matters pertaining to roads is vested in the government council, and under it, in the direction of public works to whom, outside of the district and the township authorities, the cantonal surveyer, the circuit surveyers, the overseer, and the road keepers are subject for the carrying out of the law. The government council shall, by promulgating the proper instructions, define more clearly the functions of the aforesaid officials and employés.

(47) The sheriff's offices have a general superintendence over all matters pertaining to roads, they watch over the fulfillment of obligations by the townships in regard thereto, and are in general charged with the enforcement of the law.

(48) Town councils are charged with the duty of looking after all matters pertaining to roads in their respective townships, as well as with the maintenance of the provisions for the policing of roads, and with the oversight of road-keepers on third-class roads. In cases where the town council does not possess adequate jurisdiction, it shall apply to the sheriff's office.

(49) When townships or private individuals fail to comply with any demand made upon them under the provisions of the present law, execution may be decreed at cost of the delinquent.

(50) Road keepers for first-class roads should be chosen by the direction of public works; those for second-class roads by the sheriff's offices, subject to approval by the direction of public works, and those for third-class roads by the town councils. The number and compensation of the same for first and second class roads shall be determined by the government council, and for third-class roads by the town councils.

(51) Town councils shall keep lists of all the public roads and footpaths within their respective townships.

VI.—IN RELATION TO CITIES.

(52) The cities of Zurich and Winterthur are charged with the laying out, repair, and maintenance of all streets within their respective limits. The canton contributes an amount not to exceed one-third toward the original construction or repair of such streets as are intended for through traffic, such amount to be proportioned according to the general importance of the street. But in estimating such cost of original construction, except in unusual cases, neither the expenses of expropriation or buildings, nor those outlays necessitated especially for city purposes, such as street pavements, sidewalks, drainage-sewers, etc., are to be taken into account.

* * * * * * *

(57) This law shall take effect May 1, 1871.

* * * * * * *

(58) The government council is charged with the execution of this law.

Zurich, Dec. 21, 1870.

In the name of the cantonal council.

R. ZANGGER,
President.
BOSSHARD,
Second Secretary.

Under the provisions of the foregoing law, a careful study of which in all its various details is commended to those interested in road building, the canton of Zurich last year operated 622.36 kilometres (386 miles) of first-class, and 744.21 kilometres (462 miles) of second-class roads, employing for the former 173, and for the latter 180 road keepers.

COST PER MILE PER ANNUM.

Now, taking for instance the first-class roads, it is of interest to ascertain what their maintenance cost per mile in dollars and cents for one year.

The outlays were:

	Francs.
Purchase of gravel bed	3,133.55
Uncovering and cleaning gravel	23,205.74
Bridges, sewers, and walls	18,137.48
Marks, signals, superintendence	9,803.55
Compensation paid to townships	18,633.20
Salaries and awards to road-keepers	79,378.80
Gross outlay	152,282.32
From which deduct for receipts	7,670.40
Leaving a net outlay of	144,611.92

For maintenance of 622.36 kilometres, *i. e.*, an outlay of 232.36 francs per kilometre, which is equivalent to 373.99 francs, or $72.18. This, of course, would be somewhat higher, however, than the average, as it includes the purchase of a gravel bed, the cost of which should, instead of being reckoned in any single year, be distributed over a number of years.

STREETS OF ZURICH.

It may be safely stated that in no city of the world are the streets more substantially constructed, more thoroughly and at the same time economically maintained, or more cleanly kept than in Zurich. Their neatness and cleanliness invariably excite the remark and elicit the admiration of the observant stranger. In order to give a general idea of the method of construction, materials used, etc., in the different kinds of streets, I have obtained from the city surveyor's office, and forward with this report, profiles of (1) an ordinary street in Zurich, (2) the Limmat Quay, and (3) the principal boulevard, the Bahnhofstrasse, universally admitted to be the finest street in any Swiss city. These profiles give in themselves a full and detailed description as to grades, measurements, materials, etc., and will be found of especial value to those technically interested in this subject. With a view to ascertaining further particulars relative to the cost of constructing and maintaining the streets of Zurich, I addressed a series of questions to the city surveyor covering the points stated in the Department's circular of inquiry, and have received very full replies thereto, which, with the questions, I append herewith.

According to article 53 of the cantonal law, said law, so far as concerns sections I to V, has no application to the cities of Zurich and Winterthur. The limit of public ground occupied by the streets coincides with the street borders, that is to say the street lines; embankments, in case there are such, lie on private ground. The building lines coincide, as a rule, with the street lines. In individual cases they lie further back, so that gardens may be placed before the houses. In the older quarters of the city the width of the streets has been handed down from former times. Newly laid out streets have a minimum

width of 12 metres, and, according to their importance, a width of 15 metres and upward. All streets have raised sidewalks with granite curbs. The center of the driveway is of the height of the curb, and slopes off, so that the surface lies 10 or 12 centimetres lower than the latter. The sidewalks have an inward slope (toward the street) of 5 per cent. The street is graded according to the land and to its own importance as a highway.

The street driveways are either (1) laid in concrete, (2) paved with stone, (3) or provided with pressed asphalt or (4) with wooden blocks. The sidewalks are of concrete, with either stone pavement, or with melted or pressed asphalt covering.

The cost of first construction is as follows:

Description.	Driveway (per square yard).	Sidewalk (per square yard).
	Francs.	*Francs.*
Concrete	3.34	2.09
Stone pavement	7.52	7.52
Melted asphalt	.....	9.20
Pressed asphalt	12.87	9.36
Wooden blocks	12.29	.....

The cost of annual maintenance is as follows: Concrete, 0.92 to 0.42 francs; stone pavement, 0.50 to 0.17 francs; melted asphalt, 0.42 francs.

It is to be assumed that the stone pavements of driveways must be renewed every 17 years, and the melted asphalt on the sidewalks every 10 years.

The street commission has thus far had no experience as regards the maintenance of pressed asphalt or wooden blocks, inasmuch as these latter have only been introduced of late years.

Formerly this work was charged to a special account, redeemable in 30 years, but now it is paid from the direct revenues of the city, consisting in the funds derived from real estate, capital, fees, and taxes.

Formerly all the streets in the interior of the city were provided with pavements of an inferior quality, which, however, about the year 1865, were replaced by new stone pavements, which still p artially exist The newly constructed streets of the last thirty years or so, especially those in quarters of the city not so closely built up, are all provided with concrete driveways, and with paved crossings for pedestrians at the most frequented points. Pressed asphalt and wood blocks are put down in streets in which it is important to prevent noise and dust.

All sidewalks in the interior of the city are either paved or laid with melted asphalt; in the outer quarters they are mostly of concrete only. Pressed asphalt is only used on the sidewalks of the two principal streets of the inner city, namely, the Bahnhofstrasse and the Limmat Quay.

In the choice of either one or the other kind of construction for a street, reference is had more particularly to the amount of disposable funds rather than to the question of heavy or light traffic thereon.

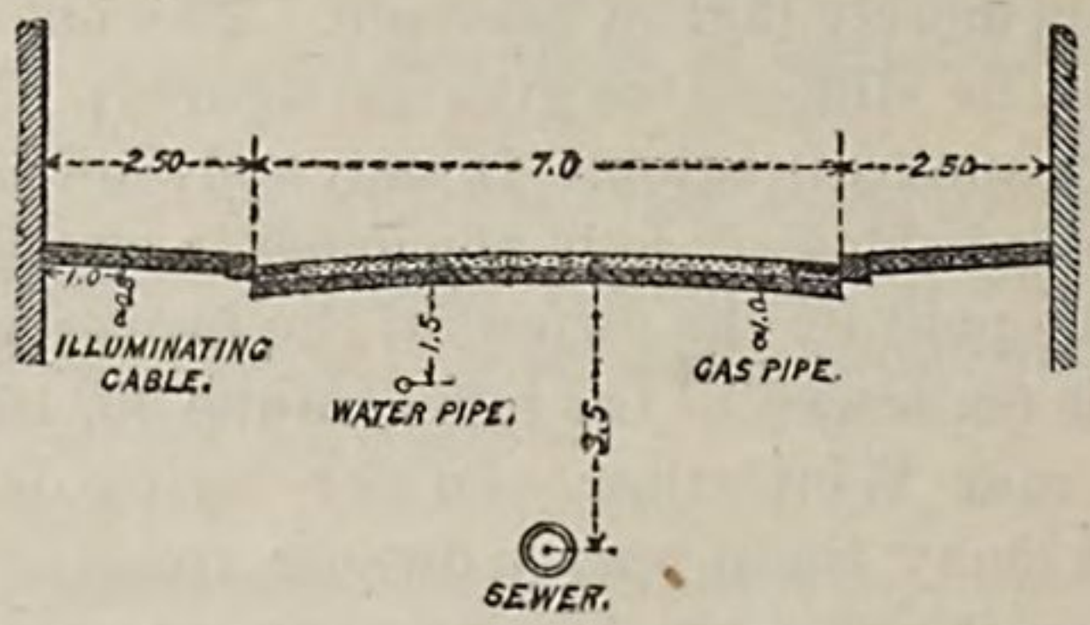
Unquestionably the condition of a street affects the adjacent property, and a good pavement certainly contributes more to values than where the street is merely laid in concrete. To what extent this exists it would, however, be difficult to give in figures; nothing has as yet been done here in such direction. It may only be mentioned that in laying down a raised sidewalk half the expense as well as half the cost of repairs must be paid by the owners of the property fronting thereon. This ordinance is embraced in the law of June 30, 1863, relative to the cities of Zurich and Winterthur. In the laying down of the newly widened Limmat Quay the property owners fronting thereon pay the difference between the wooden block pavement actually used and the stone pavement previously contemplated.

GEORGE L. CATLIN,
Consul.

UNITED STATES CONSULATE,
Zurich, January 20, 1891.

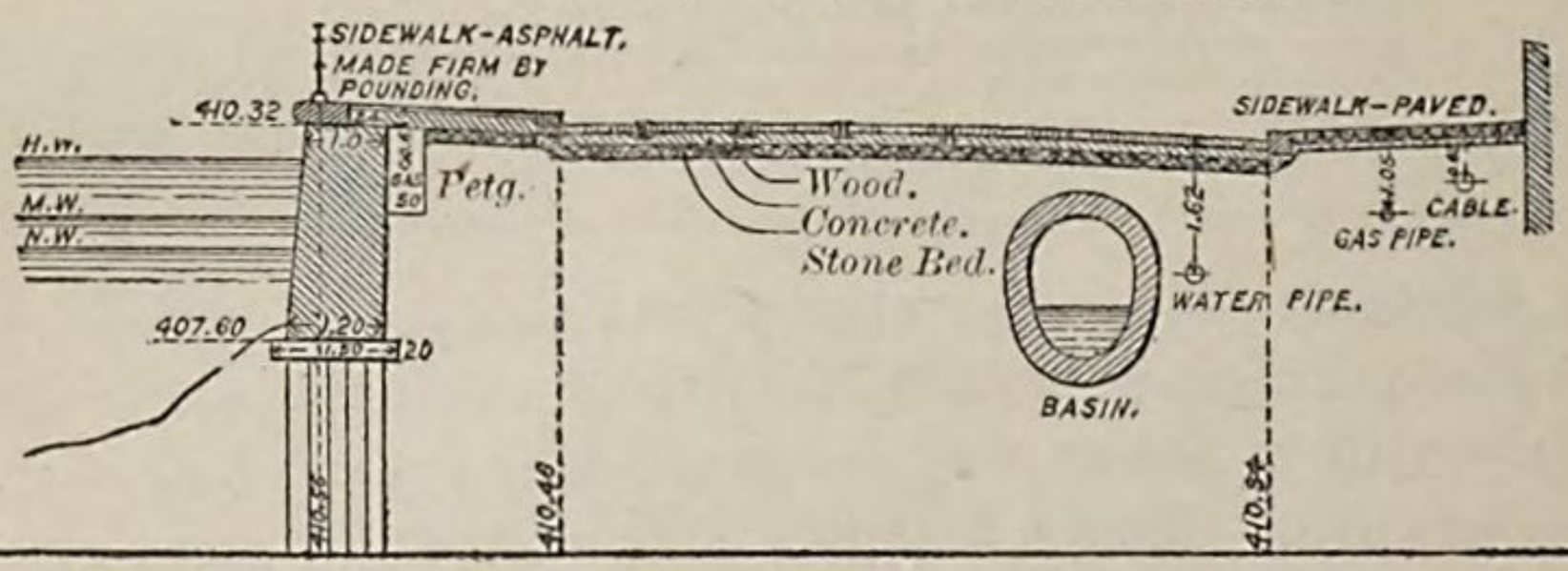
CROSS PROFILE, 1:100.

Street and Sidewalk Causewayed.



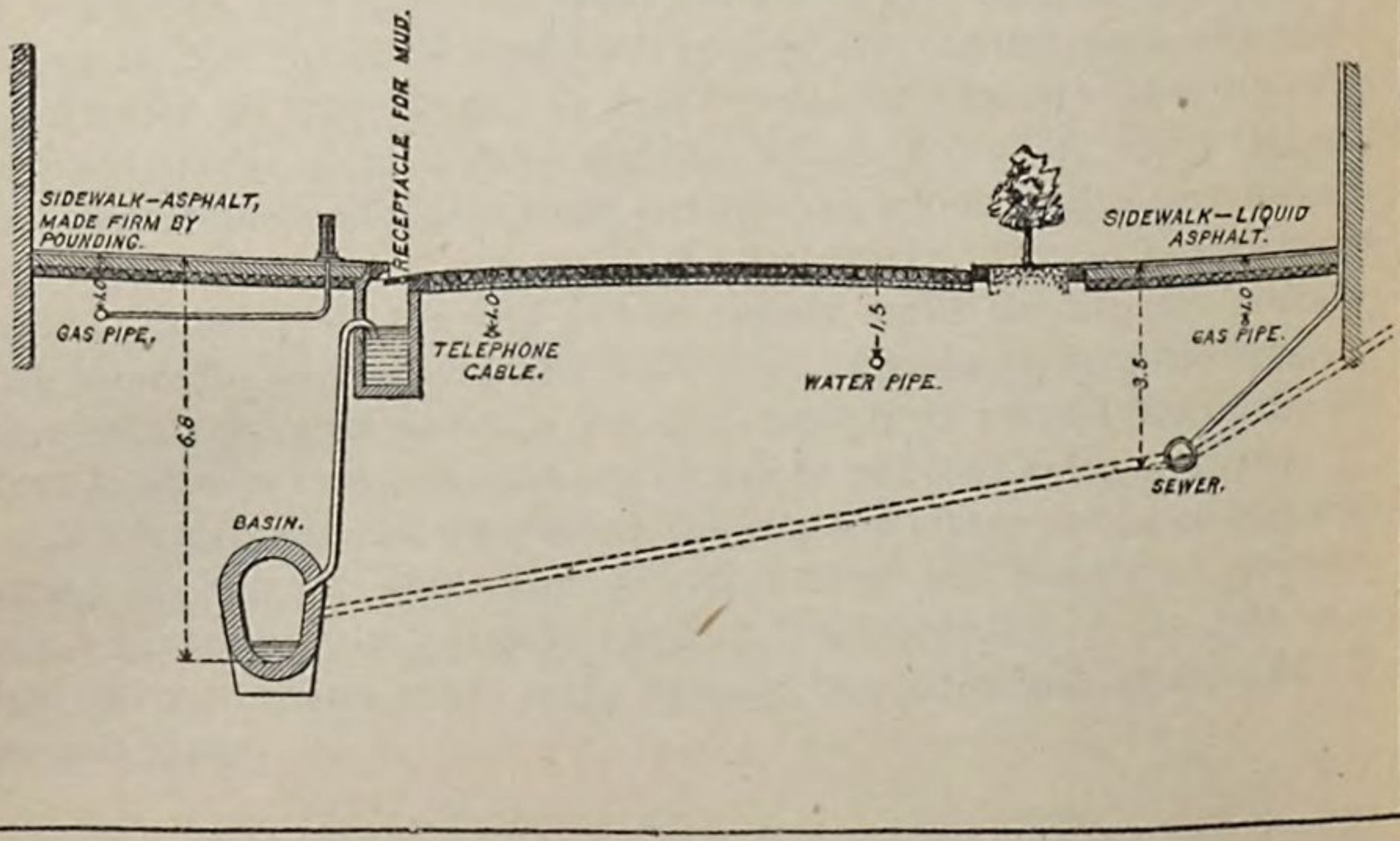
CROSS PROFILE OF THE LIMMAT QUAY, 1:100.

Street, Wooden Pavement.



CROSS PROFILE OF BRAHNHOF STREET, 1:100.

Street Paved.



SWITZERLAND.

REPORT BY CONSUL ADAMS, OF HORGEN.

ROADWAYS OF SWITZERLAND.

In any country the oldest artificial roadways are more recent than the original routes of migration, travel, and commerce. There is evidence of active intercourse along such natural routes between the primitive communities of Switzerland, Italy, and France for many centuries before the Christian era. What is now Lombardy was connected with eastern Switzerland by the Julier, Septimer, Splügen, and Bernadino passes, Piedmont with western Switzerland by the Grand St. Bernard, and the lake of Geneva with the Phœnician colony of Marseilles by a route following the Rhône Valley. This last line and the Grand St. Bernard were joined by another running from the neighborhood of Lyons over the Little St. Bernard to Aosta. All these routes differed from the local pathways leading from one camping ground or hamlet to another only as they were more frequented and therefore better trodden. The modern roadways of Switzerland, and of Europe generally, originated with the Roman engineers in the last century before Christ. Constructed in the first instance for the march of armies and the postal service of the empire, they were promptly occupied by the tributary commerce which poured into Italy with augmented volume as the dimensions of the empire increased. When the northern frontier was finally established along the line of the Danube and the Rhine, the Swiss roads acquired at once the character of transcontinental and international routes which they have retained ever since. Before the end of the third century two great systems of elaborately constructed highways connected northern Italy, across Swiss territory, with Gaul and Germany. In the west the Grand St. Bernard led from Aosta to Martigny, on the upper Rhône, where it was joined by the Simplon coming from Lago Maggiore; from Martigny the route was prolonged to Vevey, Soleure, and Augst, near Bâle, whence it descended the Rhine northwards into Germany. This great line sent off two lateral spurs into Gaul, one by Geneva and the lower Rhône Valley, the other by Poutarlier to Besacnon. In the east parallel routes led from the Italian lakes and Milan over the Splügen, Septimer, and Julier to Chur and the lake of Constance. The two systems were connected in the north by running from the upper Rhine and Lake Constance to Soleure and Bâle. These main lines threw out local branches to all the important towns and military stations of the country.

In the breaking up of society which followed the invasion of the barbarians and the fall of the Empire, the Roman roads, although in continued use, fell out of repair and finally into ruin; nor was any serious attempt made to restore or replace them until the modern communities of Europe were definitely constituted and brought into sustained

intercourse with one another. As the geographical center of the continent, Switzerland was one of the first countries to profit by the revival of the European movement. A new route was carried over the St. Gotthard in the twelfth century; the other passes into Italy, especially those diverging from Chur, on the headwaters of the Rhine, recovered something of their ancient importance; and the Julier in particular was improved to accommodate the oriental traffic which flowed through Venice until the discovery of the ocean passage by the Cape of Good Hope; much, too, was done to facilitate local communications between different parts of the country. But with all this activity and improvement the Swiss roadways remained everywhere in bad condition down to the end of the last century. Partly from faults of construction, partly from subsequent neglect, most of them were footpaths for pedestrians and pack-horses, and the best only admitted the passage of small vehicles solidly built and lightly loaded. To this are to be added the burdensome tolls and taxes in great variety exacted by the local communities, the last of which were suppressed by the federal government in 1848. In singular contrast with the immense development of architectural engineering throughout Europe during and since the Middle Ages, the Swiss roads are practically the creation of the nineteenth century.

The first great construction of the new era was the Simplon, begun in 1800 by the Emperor Napoleon and finished in 1804. The Simplon was followed by the Bernadino (1818–1821), the Splügen (1818–1823), the Julier (1820–1826), the Maloja (1827–1828), the St. Gotthard (1820–1830), the Furka, Oberalp, Albula, Flüela, Bernina, Offenberg, Lukmanier (finished 1876), and the Brünig. These great mountain roads, with the highways following the water-courses or traversing the lowlands, form the skelton of the system to which all the lesser local roads are attached. The system reached its full development between 1870 and 1880; for the last 20 years the energies of the country have gone mostly to the extension of railways. I subjoin a table giving the general statistics of the principal roadways for 1877, since when no important additions have been made to the literature of the subject. (Annex I.)

The Swiss roadways are almost entirely in the control of the several canton, and, under the cantion, of the several districts and townships. The federal government has declared all roads free for public use. It exercises a general supervision over post-roads, and, I believe, grants subsidies for the maintenance of such roads as have the character of international routes. But the building, the repair, and the police regulation of roads are in general left exclusively to the cantonal and local authorities. Yet the system is practically uniform throughout Switzerland, notwithstanding extraordinary differences in race, language, character, and usages between different parts of the population. This concordant action where great variety might be looked for, and long existed, is due to a fact without which this historical recapitulation

would lose much of its pertinence. The Swiss roadways of the nineteenth century are really a revival of Roman engineering; after centuries of mistaken experiments, a return by common consent to the Roman method of construction and the Roman selection of routes.

The Roman roadway, wherever necessary, had a carefully laid foundation of undressed stones, which was slightly convex or vaulted, and held by longitudinal borders of square stones, the whole forming a coherent and solid structure. The size of the stones so employed varied greatly in different localities according to the material available. In the great roadway of the western system traversing the lowlands between Avenches and Solothern, the foundation consisted of rolled and rounded stones, averaging 10.15 centimetres in diameter (see Annex II). On the south slope of the Septimer in the high Alps, the foundation was a compact masonry of angular stones from 0.60 to 1.50 metres in longitudinal diameter, carefully fitted together and held firmly by the pressure of the border blocks (see profile and ground-plan Annex III). On the stone foundation was spread a layer of gravel, usually mixed with argillacious sand as a binding material, and thoroughly stamped down as in our macadamized roads. This furnished a firm and smooth surface which shed the water and kept the whole structure dry (see profile Annex II). In lighter roads the gravel sometimes lay between two layers of common earth (profile Annex IV). In the Swiss roadways the depth of the structure varied from 0.70 to 1.30 metres; the surface width from 2 to 3.50 metres. The surface was sufficiently elevated to shed water, and even along mountain slopes the road-bed was let into the soil only on the upper side and only to the depth required by the conformation of the ground. The route kept, when possible, to the sunny sides of mountains, adapted itself closely to the natural curves of the surface, and avoided all avoidable cuttings, causeways, and bridging of gorges. It is upon these principles that routes, both of roads and railways, are laid out to day.

The identity of structure in the Roman and the modern Swiss roadways may be seen at a glance by comparing the Roman profiles with two others subjoined, taken from roads of the second and third classes in the canton of Bern (Annexes V, VI). The modern roadway is less solidly built, has a greater breadth (varying from 7.50 metres or more in roads of the first class to 4 metres or less in roads of the third class, and pays more attention to the lateral accessories for consolidating the adjacent soil and carrying off water. But the internal system of construction is the same in both.

Now the characteristic and essential feature of this system is the substructure of stone. It is never omitted in either the ancient or the modern roads, except where the natural foundation of the bed offers a sufficient substitute, as when the roadway is excavated in solid rock. *Ohne unterbau keine strasse* (without an adequate foundation there is no durable road). No matter on what system or with what care and ex-

pense the surface is treated, the result will be swift ruin unless the superstructure is properly supported from beneath. On the other hand, given the foundation, the surface may be treated effectively almost anywhere and adapted to any use; it may be formed of common soil if nothing better is available, or of gravel, or of both; it may be macademized or covered with any variety of pavement. The worst surface with a good foundation affords a better road than the costliest surface without a foundation. This is probably the most important lesson to be got from European experience in road-building.

It follows that in all mountain regions and in all lowlands which have been supplied by glacial action or the flow of water courses, with stones in abundance, good roadways are merely a question of time, money, and intelligence; any community may have them to the extent required if willing to pay for them. But for alluvial or deluvial soils, destitute of stones and gravel, as on the western prairies and in the valley of the Mississippi, the case is different, and little is to be learned from European methods of road building. The problem is surrounded by local difficulties which can only be solved on the spot, if at all.

To cover the inquiry submitted by the Department's circular of November 8, I will add, in conclusion, that in Switzerland city and suburban streets are only local adaptations of the ordinary roadway. Provision is made beneath the roadbed for drainage and the distribution of water and gas, and the surface, including the trottoir, is macadamized or paved in a variety of ways; but these are all external to the central structure, which is unchanged. For further details I refer to the report of the agent at Lucerne, with accompanying sections of streets and quays of the city.

LYELL T. ADAMS,
Consul.

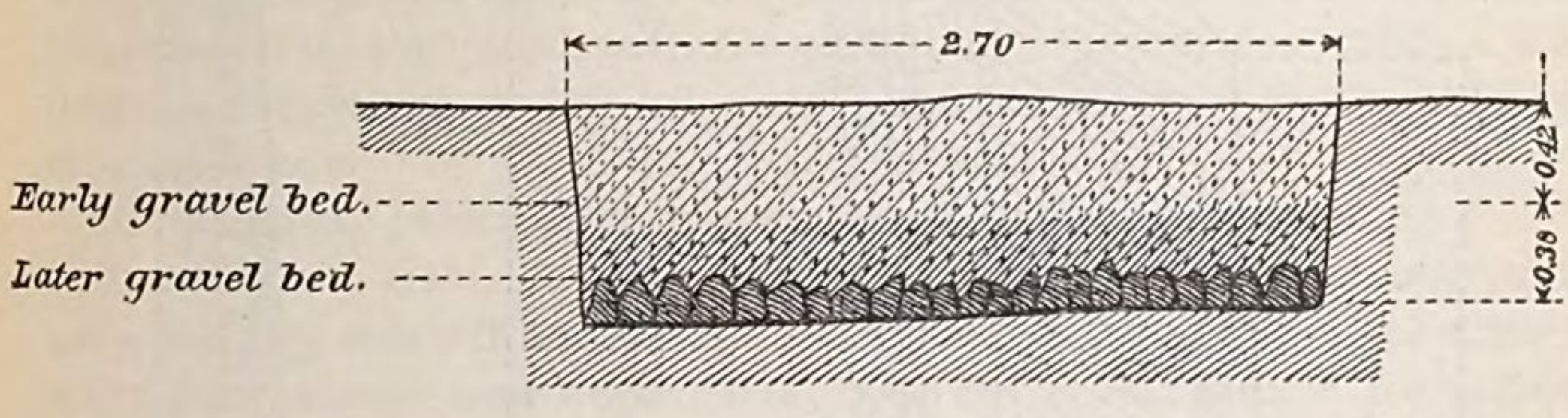
UNITED STATES CONSULATE,
Horgen, January 27, 1891.

Length and cost of the principal roadways of Switzerland in 1877.

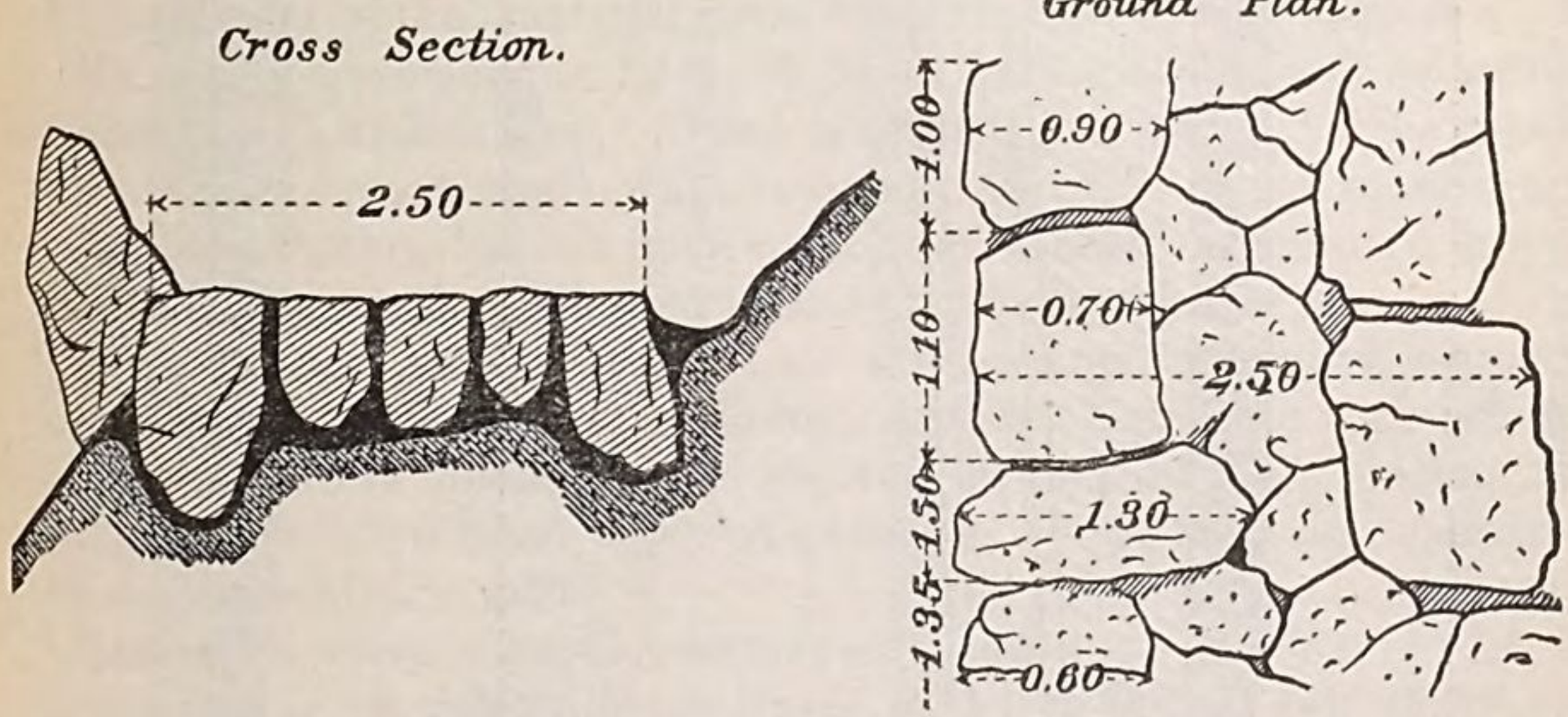
Superficial area of Switzerland	sq. kilometres..	41,390
Population in 1870		2,669,147
Length of roads:		
Class I		6,548
Classes II and III		6,806
		13,354
Length of roads of all classes per sq. kilometre of area	sq. kilometres..	323
Length of roads of all classes per 1,000 inhabitants	do....	5,003
Cost of construction of roads, Class I	francs..	173,498,400
Cost of construction of roads, Class I, per sq. kilometre	do....	4,190
Cost of construction of roads, Class I, per 1,000 inhabitants	do....	65,000
Average cost of roads, Class I, per kilometre	do....	26,480

This tables includes only roads whose widths is not less than 4.20 metres. The increase of roadways since 1877 has probably kept pace with the increase in population (estimated in 1888 at 2,934,000), so that the proportions remain about the same. Statistics of the cost of roads of Classes II and III for the most part built by the townships, are incomplete.

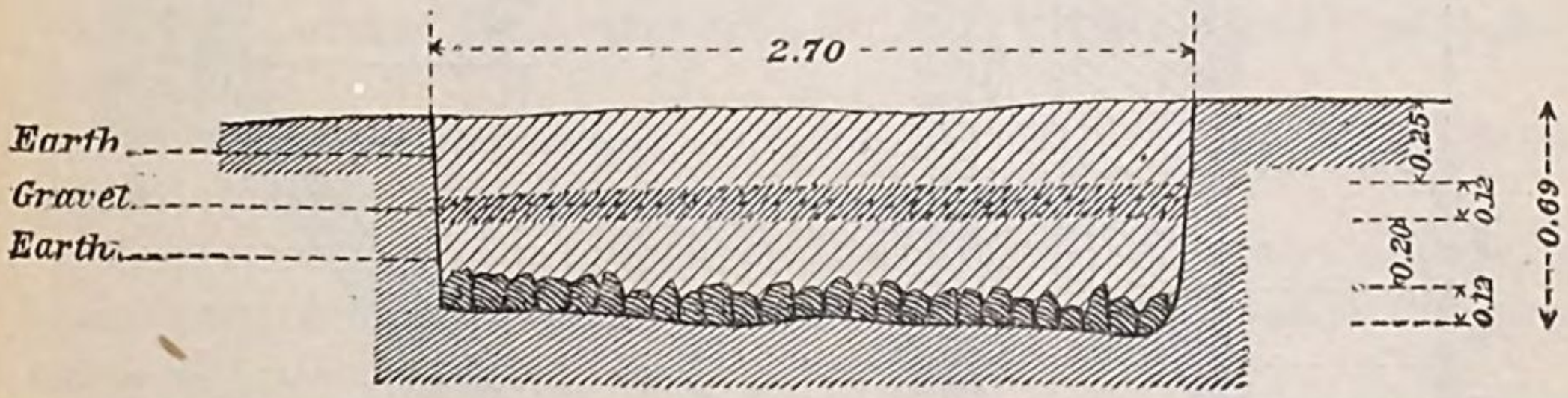
Roman road below Kallnach, between Grenches and Soleure.

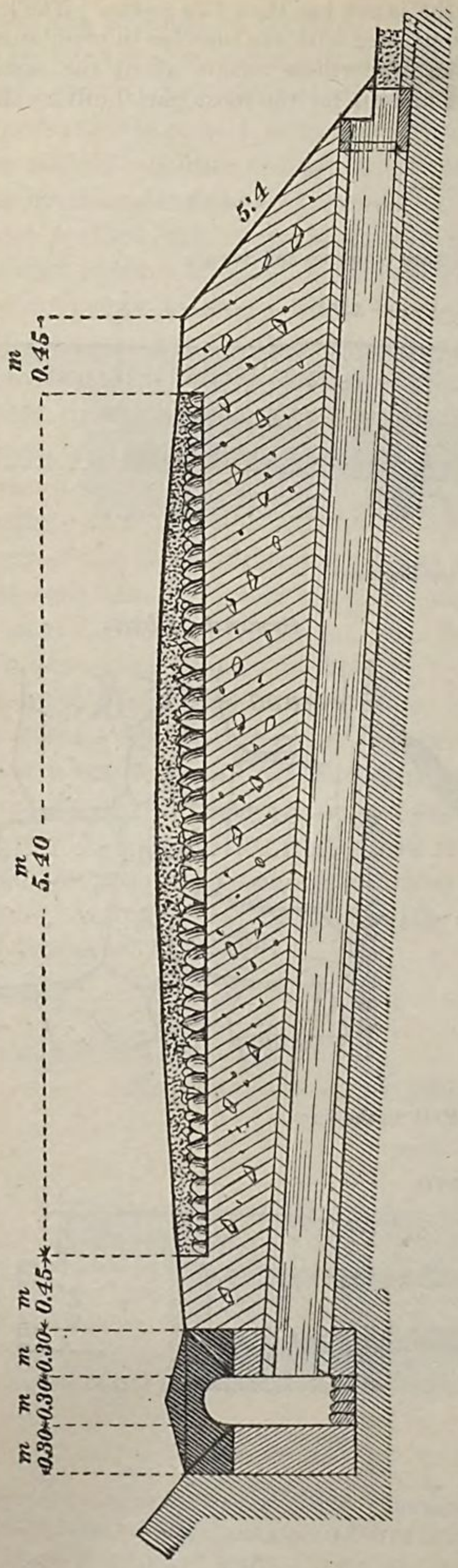


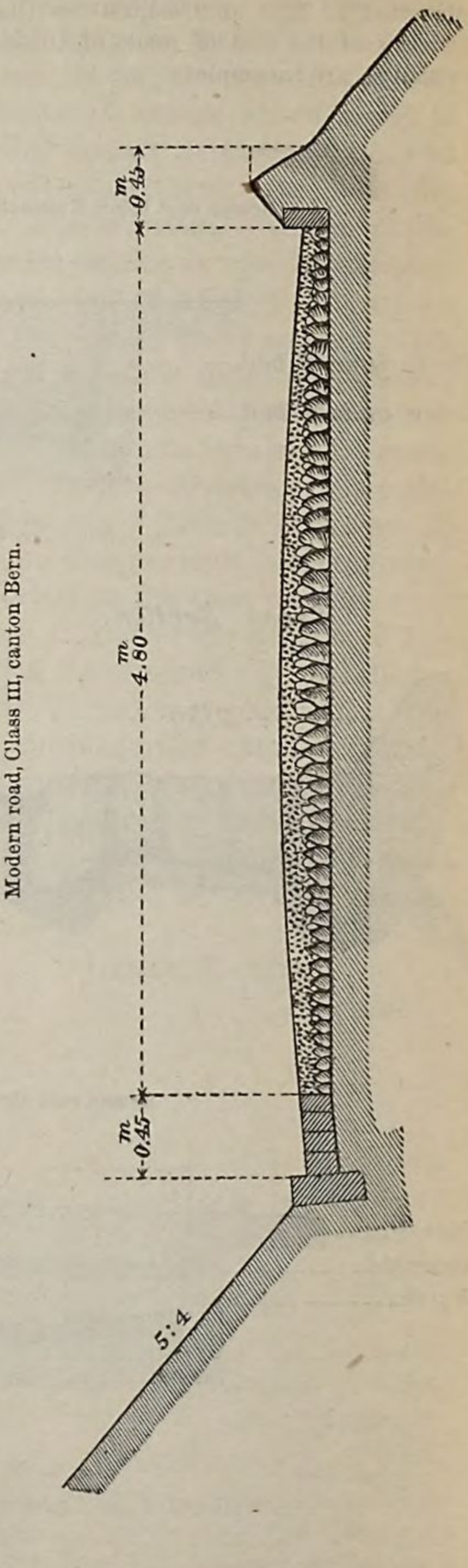
Roman road on the Septimer.



Roman road above Mett in the Jura.




5:4
m 0.45
Modern road, Class II, canton Bern.
m 5.40
m 0.45
m 0.30
m 0.30
m 0.30
m 0.45


m 0.45
Modern road, Class III, canton Bern.
m 4.80
m 0.45
5:4

CANTON OF BASLE.

REPORT BY CONSUL GIFFORD.

CITY STREETS.

The streets of the canton of Basle City were for the most part built in the last century, but have been several times improved in recent years. There is no division of these streets into classes, and the city, which embraces substantially the whole canton, builds and maintains the same at its own cost, with the exception of a few field roads. The length of the streets is 102 kilometres and the steepest grade admitted is 5.40 degrees.

The following information relates to streets built in late years:

Material and cost.—For the paved streets three different materials are used, viz, stone from the Rhine—so-called Rhine pebbles—quarry stone from Alsace, and wood. The cost of the Rhine pebbles is from $2 to $2.30 per cubic yards, that of the quarry stone, 3 cents for each block; the dimensions of which are 5 by 7 by 6½ inches. The wood for pavement of that material costs from $7 to $8 per cubic yard.

The stone pavement is from 4¾ to 5⅛ inches thick, laid on a sand foundation 2½ inches deep. When constructed of Rhine pebbles it costs 65 cents per square yard; when of quarry stone, $1.60 per square yard

The wood pavement is 4 inches thick on a beton foundation from 6 to 8 inches in depth. The cost is $2.50 per square yard.

Macadamized streets are laid on a limestone foundation 6 inches deep over which is a layer of broken stone rolled down with cement. A square yard of finished street costs from 45 to 50 cents. Along the sidewalks is constructed a paved gutter 3 feet wide, at an expense of 65 cents per square yard.

Sidewalks have a border, composed of strips of granite, 10 by 12 inches in size, costing $1.50 per linear yard. In the interior of the city these sidewalks are of Travers asphalt, four-fifths of an inch deep, laid on 4 inches of beton. In the suburbs the material used is gravel and sand. The cost of the former is $1.25; of the latter, 6½ cents per square yard.

The breadth of the streets is 10, 13, 16, and 20 yards, the sidewalks constituting one-fifth of the width in each case.

Maintenance.—The maintenance of the paved steeets is reduced to raising the sunken portions as required and the renewal of the pavement after the lapse of 15 or 20 years.

Each year the macadamized steeets are ballasted according to the wear to which they have been subjected. The material used for this purpose is for the most part broken stone; less frequently, round pebbles of the proper size. In both cases the stone is dumped in the street and left to be crushed by the passing teams.

The yearly expense of keeping a macadamized street in repair is $310 a mile.

The details of this very considerable expenditure are for the 102 kilometres of macadamized street in this canton as follows:

	Francs.
19 street surveyors	25,100.40
61 workingmen	32,732.30
7,017 cubic metres material	16,543.83
Cartage	17,483.40
Labor at gravel pits	2,337.80
Watering, etc	9,253.09
Total	103,650.82

Street Department.—The building and maintenance of the streets is intrusted to the building department of the cantonal government, the chief of which is a member of the executive council. The other officers of the department are the secretary, treasurer, a cantonal engineer, assistant engineer, and a road surveyor. The city is divided into nineteen districts, each of which is cared for by an assistant surveyor and 2 or 3 laborers. The cost of this department is $5,900 a year, exclusive of the salary of the chief and the wages of laborers.

GEORGE GIFFORD,
Consul.

UNITED STATES CONSULATE,
Basle, January 20, 1891.

GENEVA.

The roads in my consular district having been laid out by the ancient Helvetians many hundred years ago, are kept in order now simply by the addition of broken stone occasionally. Great age with the assistance of the broken stone have made the roads about as perfect as can be desired. The streets recently put down in the city of Geneva, were given out by contract to Americans who put down the modern block so well known at home.

ROLAND J. HEMMICK,
Consul.

UNITED STATES CONSULATE,
Geneva, December 23, 1890.

LUCERNE.

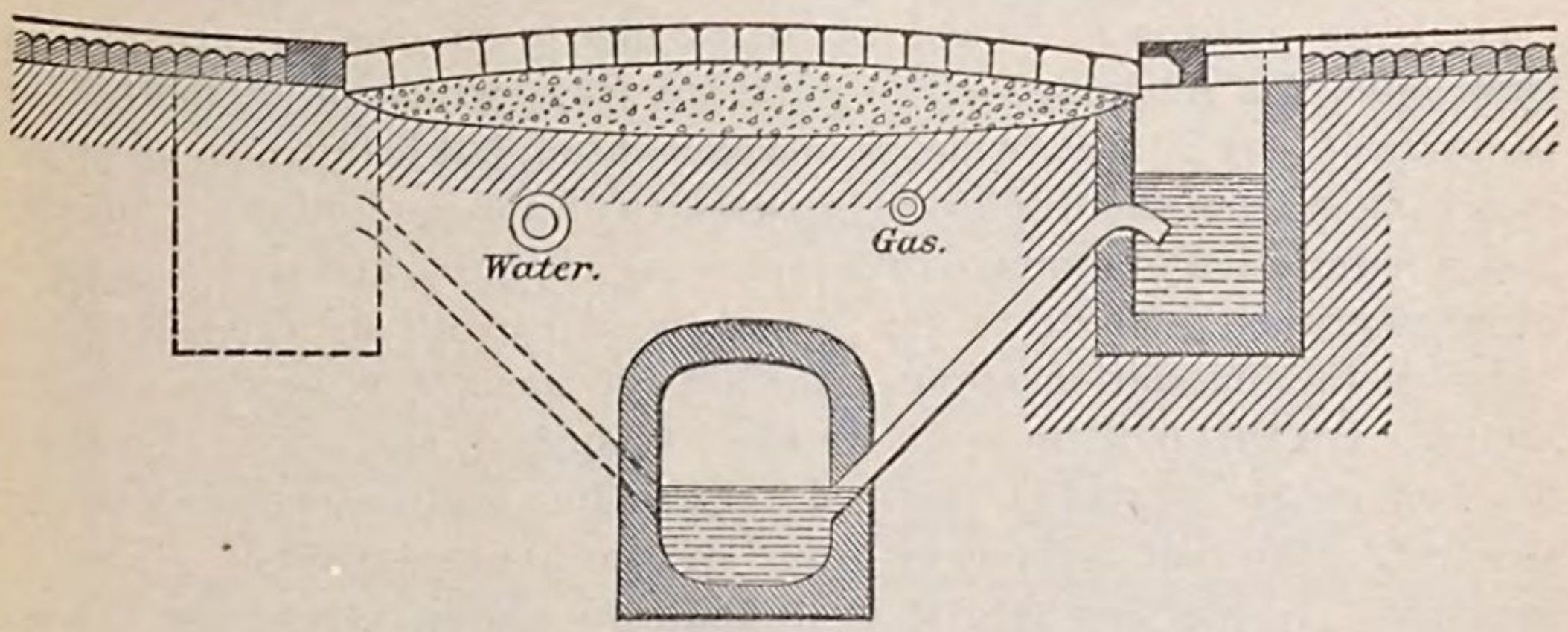
REPORT BY CONSULAR AGENT WILLIAMS.

CITY STREETS.

The city of Lucerne being very ancient, the streets are, as a rule, very narrow, but if they can not be improved so far as width is con-

cerned, they are kept in very good order. In the old part of the city the streets are paved with squared river stones of about 6 inches on each side. These are laid in regular courses, running across the roadway, and breaking joint with each other. The carriage way has a slight rise or convexity in the middle in order that water may run off it towards the sides. This convexity is from 2½ to 3 per cent. The footways are nearly level with the highest part or crown of the carriage way, and have a slope of 2 per cent. towards the carriage way. The curbstones are of granite, and now all the footways in Lucerne are finished with asphalt. The way of constructing these asphalt footways is as follows:

The ground is excavated to a sufficient depth, and then a foundation of stones, 6 inches high, is carefully laid by hand, and then covered with a layer 2 inches thick of concrete composed of cement, hydraulic lime, gravel, and sand. The concrete is properly smoothed and leveled and left some time to harden, after which it is covered with a layer of asphalt averaging three-fourth inch in thickness. Under the center of the carriage way, and at a depth of from 6 to 8 feet, runs the sewer or drainpipe, into which the water runs through the "gully holes," which are situated on each side of the roadway at distances of from 100 to 200 feet from each other, according to the gradient of the street. In order to prevent the escape of foul air through them, they are provided with siphon traps. The following section of a street shows the mode of construction.

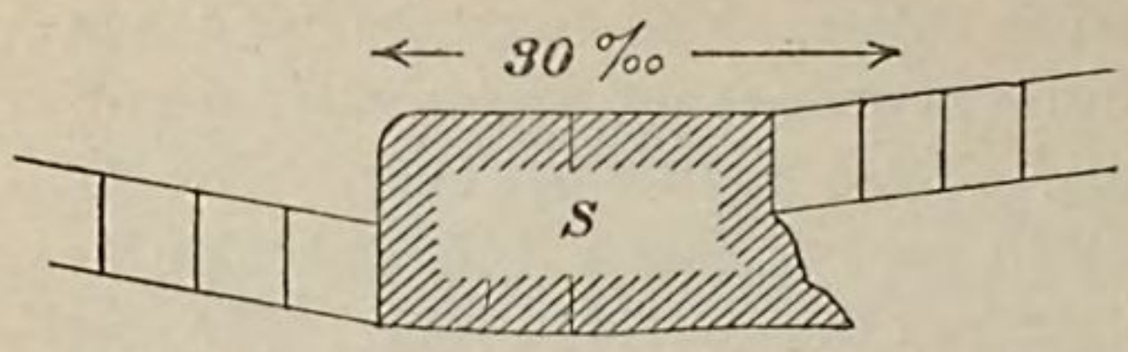


Formerly the footways were paved with small square paving stones, and there are still a few in the city, constructed in that way, but this system is now abandoned, as asphalt is found better in every way. A paved footway lasts about 15 years but it often requires to be releveled. An asphalt footway lasts about 20 years and if well made in the first instance requires little or no repairs.

COST OF PAVED STREETS.

(1) Cost of paving with well-cut river stones, including labor, per square metre, $1.16.

(2) During the last 20 years the streets of Lucerne have so often been cut up for the purpose of laying drains, water pipes, gas pipes, electric-light wires, etc., that it is impossible to give the cost of repairs.



(3) Granite curbstones for footways: Straight per metre, $1.06; curved, per metre, $1.26; laying curbstones, per metre, 20 cents.

(4) Paving footways with small squared stones laid in sand, per metre, $1.16.

ASPHALT FOOTWAYS.

Stone foundation, 15 centimetres high, covered with concrete, made of cement and hydraulic lime, 5 centimetres thick, per square metre, 48 cents. Asphalt, 2 centimetres thick, per square metre, 97 cents.

HIGHWAYS.

In the old diligence days the postal roads of Switzerland were celebrated, and although, since the introduction of railroads the same amount of care has not been given to the maintenance of highways, still I think that the Swiss postal roads would compare favorably with the roads of almost any other nation. I do not know if the system of construction is the same all over Switzerland, but probably it is so. In the canton of Lucerne highways are constructed in the following manner:

(1) If the road is in level ground, or nearly so, ditches are cut on each side, for draining. The carriage way, which is 9 metres, or thereabout, say 30 feet, wide, is not excavated, but leveled, some of the earth taken from the ditches being used to fill up the hollows. On this bed a foundation of stones 8 or 9 inches high is built, and on this a layer of large gravel, generally river gravel, is laid to fill up the interstices between the foundation stones; the size of the gravel used is about 2 inches. On this a little earth or sand is spread, and above it a thick layer of coarse gravel is laid. After this has become consolidated by the traffic, the road is kept in order by successive layers of gravel as required. In places where it is difficult to obtain river gravel, hard broken stones are used instead, something after the system of Mr. Macadam, except that a stone foundation is always used, which Mr. Macadam never made use of. When broken stones are employed it is necessary to loosen the surface of the road with a pick before the addition of each layer of material.

(2) When the road is made on a slope, a shallow ditch is cut on the upper side. The water runs in gully holes, and is carried under the road to the lower side by cement pipes, with an internal diameter of from 8 inches to 24 inches, according to the volume of water to be carried away. When the roads are made on mountain sides, where streams of water or small torrents come down from the heights, instead of pipes

a culvert is built of a size suitable to the requirement. In that case, the lower side of the road, instead of being an earthen embankment, generally consists of a retaining wall, well pierced with draining holes.

(3) All the roads have a convexity of about 4½ or 5 per cent. to enable the rain water to run off to the sides.

These high roads are very hard, and are soon dry after rain.

I inclose herewith four tracings of sections of roads in or near Lucerne, kindly supplied to me by the director of constructions of the city of Lucerne, which show clearly the method of road building.

COST OF HIGHWAYS.

(1) Stone foundation of rubble or river stones, not less than 8 inches high, per square metre, 39 cents; river gravel, from 2 to 2½ inches, per square metre, 5 cents; broken stone, 6 to 7 cents.

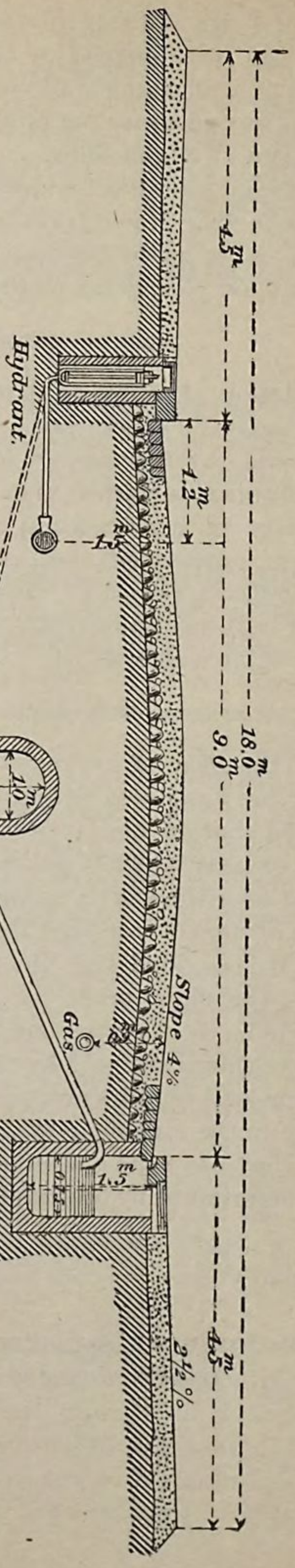
The price of maintenance varies, as is shown by the following figures: 1875 (great activity in construction) cost, per square metre, 4 to 5 cents; 1881 (works suspended) cost, per square metre, 2 to 3 cents; 1890 (great activity) cost, per square metre, 3 to 4 cents; broken stones delivered on road cost, per cubic metre, $1,31. River gravel delivered on road cost, per cubic metre, $1.04.

EFFECTS OF IMPROVED HIGHWAYS.

With regard to the effect of improved public roads upon land values in the country, I am unable to speak, but in the neighborhood of the city it is estimated that an improved carriage way augments the value of lands through or near which it passes from 6 to 12 per cent. When an improved road near the city is required it is customary for the proprietors, through or near whose land the road is to pass, to petition the city council. If it is decided that the road be made, the municipality undertakes to get the plans made by its own engineers, and to have the road constructed. It also pays one-third of the cost of construction. The remaining two-thirds are paid by the proprietors, in proportion to the extent of their land and its nearness to the road. The proprietors have also to pay to the municipality a yearly tax for the maintenance of the road, but they have the option of redeeming it by one payment. The roads being maintained by the municipality are always kept in good order.

ERNEST WILLIAMS,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Lucerne, January 5, 1891.



Hirschmatt street, Lucerne.

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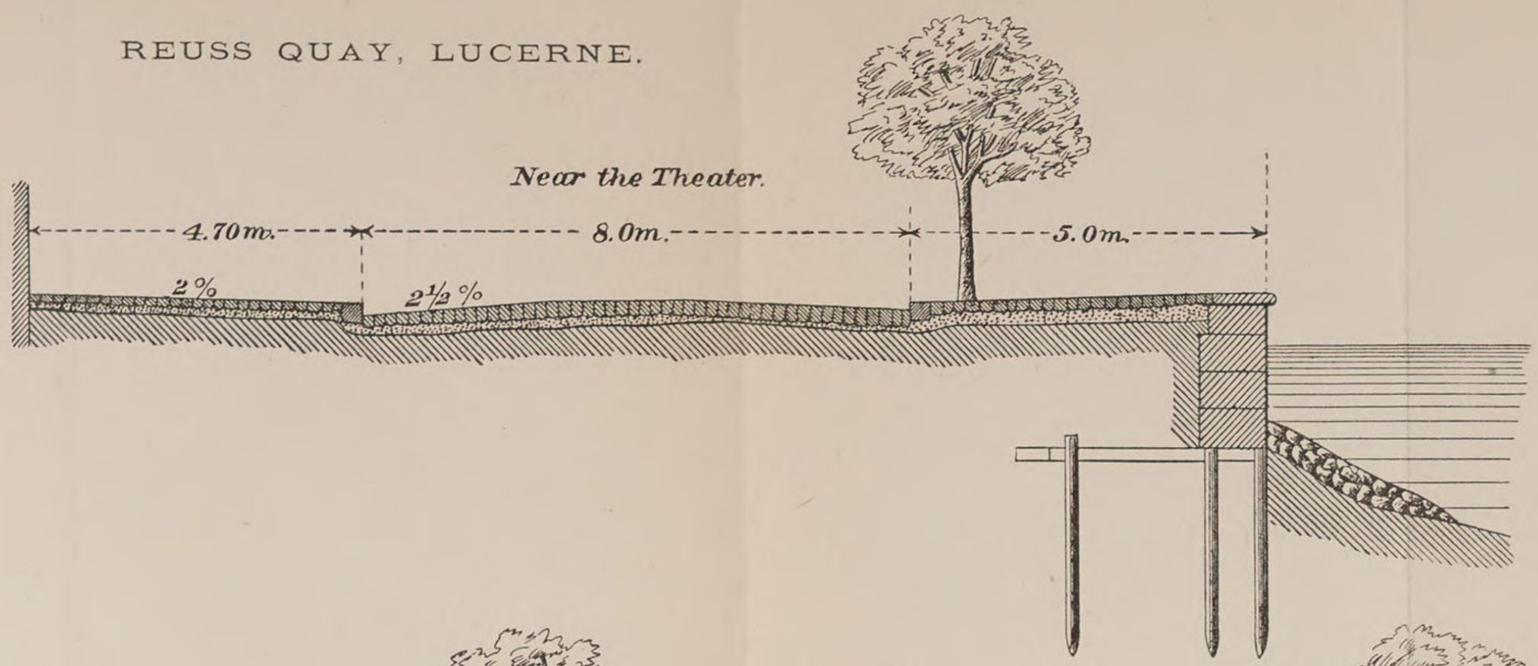
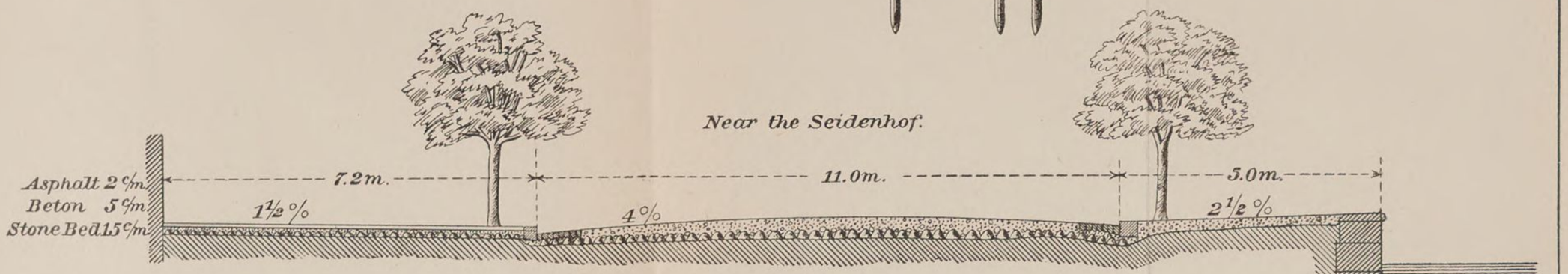
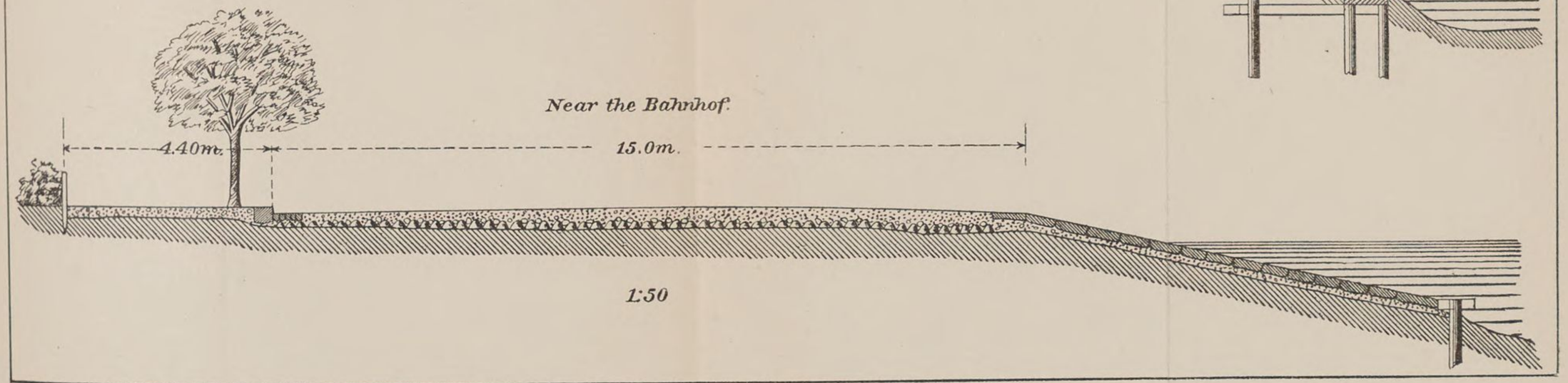
REUSS QUAY, LUCERNE.







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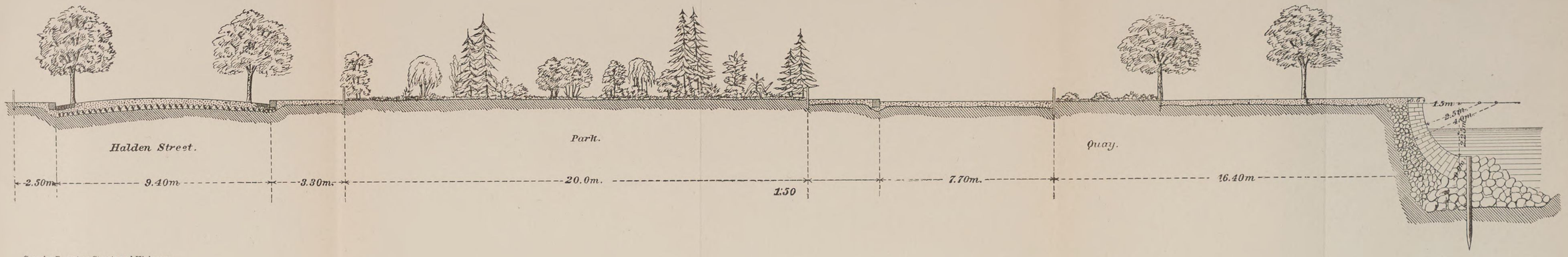
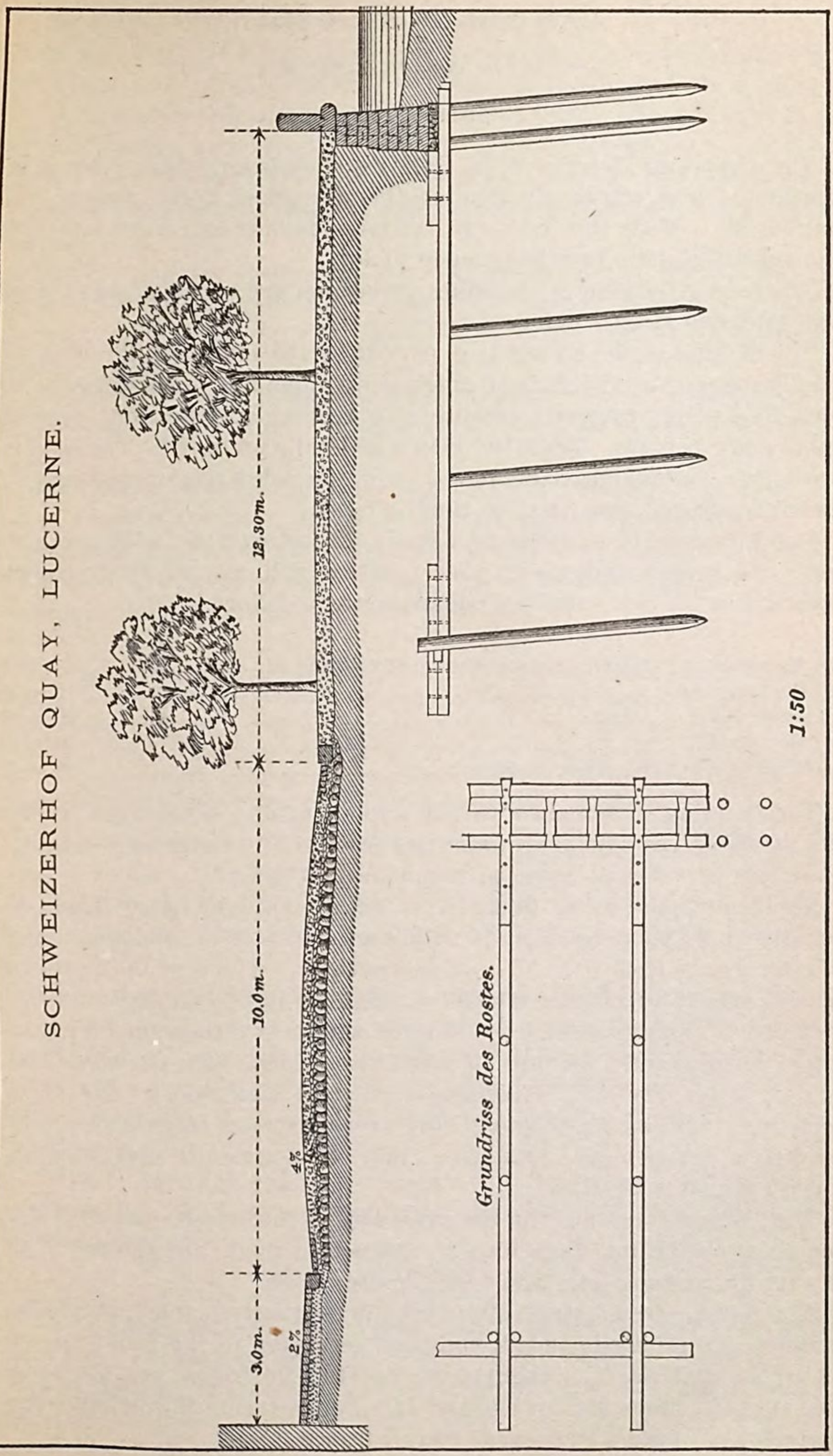
NATIONAL QUAY AND HALDEN STREET, LUCERNE.



SCHWEIZERHOF QUAY, LUCERNE.



CANTON OF ST. GALL.

REPORT BY CONSUL ROBERTSON.

STREETS.

The streets of the city of St. Gall are surprisingly bad, when it is considered how constantly they are being worked upon, cleaned, repaired, etc. With this, however, the large falls of snow and rain and the general climate here have much to do.

The laws governing the building inspection and repair of the streets are strict and strictly enforced.

The making of the streets is given out by the municipality either to regular employés, and under municipal direction and supervision or to outsiders under contract according to regular specification, general rules, and estimates. The latter plan is generally preferred. The streets are either macadamized or paved, and the sidewalks macadamized, paved, asphalted, cemented, or tiled.

One kilometer of macadamized street, 12 metres wide, with two gutters, and sewers underneath these gutters, will cost 22,000 to 55,000 francs, and the sidewalks per square metre as follows:

	Francs.
(*a*) Macadamized with stone bed and covered with gravel	3 to 5
(*b*) Smooth paved	10 to 25
(*c*) Asphalted	20 to 30
(*d*) Cemented	18 to 32
(*e*) Tiled (plates of Sinzinger material)	18 to 32

The building of streets with sidewalks, gutters, sewers, etc., raises the values of the adjoining properties from 3 to 10 times over original ones, and in somes places even as much as 30 times.

Streets of the so-called first class which are used by heavy teams receive a quarry stone bed from 15 to 30 centimetres thick, and a covering of river gravel from 10 to 15 centimetres thick. Those of the so-called second and third classes which are used for light teaming receive a stone bed of quarry stone from 10 to 18 centimetres thick, and a covering of river gravel from 6 to 10 centimetres thick. For the stone bed is used only very hard sandstone (gray-blue sandstone). Gravel is sometimes used as a concrete. For covering streets there is generally used river gravel mixed with some sand. Sometimes, to save expense, quarry gravel is used.

The sidewalks are built in the same way as the streets, only that the concrete will be but from 6 to 8 centimetres thick, and the covering of very fine gravel, from 3 to 4 centimetres thick.

A square metre of street stone bed, 30 centimetres thick, purchase, hauling, and laying included, will cost, according to the country from which the material is brought, from 2.80 to 3.20 francs, and the same for sidewalks from 0.80 to 1.10 francs. For covering the building department pays per metre from 5.80 to 7 francs.

The paving of streets is made as follows:

(*a*) *Streets of first class.*—The stones are cut out of sound quarry stones, the upper part being made very smooth, and the dimensions are either 15 by 15 centimetres or 12 by 15 centimetres. The height is from 16 to 18 centimetres, and the stones ought to be cut as sharp as possible. Under the pavestones is laid a sand bed 18 centimetres thick. The joints of the stones when laid should not be more than 1 centimetre apart.

(*b*) *Streets of the second and third classes.*—The pavestones are cut from the same material as in the case of streets of the first class, only they are smaller at the top. The height is the same, as well as the bed.

(*c*) *Sidewalks.*—For these, small pavestones are used, and they may be of different colors. Underneath is a sand-bed from 12 to 15 centimetres thick.

The cost of building streets in the city of St. Gallen varies according as to whether the latter are made on level ground or on hillsides.

For instance, taking six of the town streets here, 7 metres wide, macadamized, the cost of a running metre, with sidewalk, gutters, sewers, expropriation of the land, etc, is respectively:

	Francs
Dufour street, with roadway of 5 metres and sidewalk of 2 metres	98.80
Fwingli street, with roadway of 5 metres and sidewalk of 2 metres	85.50
Winkelried street, with roadway of 5 metres and sidewalk of 2 metres	114.00
Vambühl street, with roadway of 4.5 metres and sidewalk of 2.5 metres	111.00
Wildegg street, with roadway of 5 metres and sidewalk of 2 metres	101.50
Treuacker street, with roadw ay of 5 metres and sidewalk of 2 metres	86.70

A square metre of a paved street costs from 100 to 130 francs. The cost of building the streets and of expropriation of the necessary land are paid by the city, but the adjoining property-holders having houses built along the streets pay upon the total cost sometimes as high as 60 per cent.

The cost of repairing the streets is paid by the city, and amounts, per year per square metre, for macadamized street, to from 0.80 to 1.10 francs; for paved street, to from 0.50 to 10 francs. In the case of paved streets, the cost of repair for the first few years is very small, but when the stones begin to settle or to wear out the cost of repair increases very much.

Experience has shown that it costs much less for the repair of streets paved with small stones as compared with that of those in which large stones are used.

HIGHWAYS.

The country roads of this portion of Switzerland are especially good, and receive constant attention.

The expenses of building and repairing the post or state roads are paid by the national government. Those for the cantonal roads are paid by the canton.

In building a country road, a stone bed from 20 to 25 centimetres thick is made with a covering of gravel from 10 to 15 centimetres thick.

The cost of 1 kilometre of road, purchase of ground included, is, at the minimum, 15,000 francs, and in some localities as high as 100,000 francs.

The use of material depends largely on the location or nature of the country through which the road is to run. For the stone bed, river stones are generally preferred, and for the covering river gravel, but where these can not be had quarry stone and quarry gravel are substituted.

The cost of keeping the road in good order will be, per year, from 300 to 2,500 francs per kilometre, according to the use of the road and the price and quality of the material used for repairing it.

I received last year a letter from A. L. Bancroft, dated San Francisco, June 25, 1890, which, with my reply to the same, will prove interesting in this connection. Our correspondence was as below given:

SAN FRANCISCO, *June* 25, 1890.

DEAR SIR: A movement is inaugurated in one of our counties to name and measure the roads, number the country houses, and place guideboards at the crossings and junctions. As interest is already manifest in other directions, and the movement is likely to spread, I would be thankful to know something of these features in the country where you represent our Government.

Are the country roads named? Are the country houses numbered? If they are numbered, is it done upon any such plan as the "ten-block system"? Are there any celebrated roads, ancient or modern, like Via Appia and Strada della Cornice, of Italy, Watling Street, of England, and the National Road from Washington to Cincinnati in the United States? Will you kindly give the names and descriptions of some of the noted roads in your country?

I will probably make use of the information asked for in a paper for publication. By complying with this request I will esteem it a particular favor.

Very truly,

A. L. BANCROFT.

Mr. W. HENRY ROBERTSON,
United States Consul, St. Gall, Switzerland.

To Mr. Bancroft's letter I replied as follows:

UNITED STATES CONSULATE,
St. Gall, Switzerland, July 19, 1890.

SIR: As an answer to your letter of the 25th ult., I do not think I can do better than to send you the enclosed copy of a reply from the honorable secretary of the interior, of the canton of St. Gallen, to an inquiry of my own based upon the subject of your communication, above referred to. The honorable secretary has very courteously, promptly, and, I think, very clearly, covered the points to which you referred. I take pleasure in serving you in this matter.

Respectfully,

W. HENRY ROBERTSON,
Consul.

A. L. BANCROFT, Esq.,
132 *Post Street, San Francisco.*

[Inclosure.]

ST. GALL, *July* 18, 1890.

To the Honorable W. HENRY ROBERTSON,
United States Consul, St. Gall:

I hasten to answer your very esteemed letter of to-day with the following notes:

(1) Are the country roads named?—Answer. They generally bear the names of the principal places they connect. So have we, for instance, the St. Gallen, the Zurich road, the Rorschach road, the Thurgan road, etc.

(2) Are the country houses numbered?—Answer. Yes; but the houses bear only a number indicating the fire insurance, and are of no use in guiding the public. The numbers do not follow each other regularly. A new-built house often gets the next highest running number. But every isolated farm has its own name. The same is the case with every little hamlet. The country people are well acquainted with these names, which very often date hundreds of years ago. If a letter to a countryman must be addressed, it will bear the name of the house or hamlet, never the number of the house.

(3) Are there any celebrated roads like the Via Appia or the National Road from Washington to Cincinnati?—Answer. Yes. The Alpine passes, for instance, the Gotthard road, the Simplon road, the passes of Furca, Oberalp, Albula, Tulier, Spliigen, Bernina. In the level country there are no roads with well-known historical names. The country roads are divided by kilometre stones. At every distance of 1 kilometre there is a small stone, and every 5 kilometres is put a large one. At junctions and crossings are high iron or wooden posts, which guide the public and note the distances to the nearest villages and cities. The system of dividing the streets (roads) in imaginary blocks could in our mountainous and hilly country scarcely be adopted. In our cities this system is in use also, but in the country, where very few new houses are built, it would not apply. There in the United States most houses are situated alongside public roads, while in many parts of Switzerland the houses are scattered and sown all over the hills and valleys, and only by narrow footpaths connected with the main roads.

I shall be very glad, Mr. Consul, if I can serve in this matter or in any other way, and I only beg to excuse my English.

With highest esteem, I am, sir, your obedient servant,

W. KÜNZLE,
Secretary.

In thus concluding, I beg to acknowledge the very valuable assistance rendered me by the building department of the canton of St. Gall in the preparation of this report.

W. HENRY ROBERTSON,
Consul.

UNITED STATES CONSULATE,
St. Gall, March 7, 1891.

UNITED KINGDOM.

ENGLAND.

BRITISH HIGHWAYS.

REPORT BY CONSUL JARRETT, OF BIRMINGHAM.

It is impossible in a report like this to present a survey of the highways of Great Britain, or to give a detailed statement of the method of their construction.

Construction.—Many of them were designed and built by the Romans, and as far as I can discover, nearly all of the existing national roads were designed and constructed before the commencement of the present century.

The systems on which these roads were constructed all involved the preparation of the ground, according to the character of the soil on which the road was built. Pounding the soil to make it firm, driving in piles, or laying on planks or logs crosswise if the soil was boggy, or sometimes placing large rocks, were the usual way of preparing the substratum. This being done, a bed of concrete from 6 to 10 inches thick, or large blocks of stone were carefully and compactly laid to form what was called the subroad, over which was placed the road proper, which was composed of either prepared slabs or blocks of stone, broken stone, or gravel and sand.

About a century ago John Loudan Macadam inaugurated a new system of road making and repairing, to explain which I can do no better here than insert an article clipped from the Southern Planter, of November last, which I find is taken from the evidence of Macadam taken before a Parliamentary committee in 1889:

> Macadam's plan of road making differed as much from the old way which he found in operation as a bridge does from a ford. Instead of going deep for a "bottoming," he worked solely on the top. Instead of producing a peaked, roof-like mass of rough, soft rubbish, he got a flat, smooth, and solid surface. In lieu of a road 4½ feet through, he made one of at most 10 inches in thickness; and for rocks and bowlders he substituted stone broken small. His leading principle was that a road ought to be considered as an artificial flooring, so strong and even as to let the heaviest vehicle pass over it without impediment. Then people began to hear with wonder of roads 30 and 40 feet wide rising only 3 inches in the center, and he propounded the extraordinary heresy that a better and more lasting road could be made over the naked surface of a morass than over solid rock. Another of his easy first principles was that the native soil was more resistant when dry than when wet, and that, as in reality it had to carry not alone the traffic but the road also, it ought to be kept in a condition of the greatest resistance; that the best way of keeping it dry was to put over it a covering impervious to rain—the road, in fact; and that the thickness of this covering was to be regulated solely in its relation to its imperviousness, and not at all as to its bearing of weights, to which the native soil was quite equal. Instead of digging a trench, therefore, to do away with the surface of the native soil, he carefully respected it, and raised the road sufficiently above it to let the water run off. Impermeability he obtained by the practical discovery

that stones broken small and shaken and pressed together, as by the traffic on a road, rapidly settled down face to face and angle with angle, and made as close a mass as a wall. Mankind now believe that this last is all that Macadam invented; the rest is forgotten. That important fraction of his discoveries is what has given to us the verb to macadamize ("to pave a road with small broken stones."—Skeat).

Surprise followed surprise. Roads which were mere layers of broken stone, 6, 4, and even as little as 3 inches in thickness, passed through the worst winters without breaking up, while, as the coachman used to say, they "ran true; the wheel ran hard upon them; it ran upon the nail." Commissioners could not believe their eyes when they saw new roads made for much less than it had cost them yearly to repair the old ones. When an old road was given into Macadam's charge, he often made a new one of it for £88 ($440) a mile, while around London the cost of annual repairs had been £470 ($2,350) a mile. For he knew that the roads—such had been the ignorant waste—generally contained materials enough for their use for several years if properly applied. Unless the road was hopeless, he went to work in a practical, cheap way; first cutting off the "gridiron" of ruts in the center "to a level with the bottom of the 'furrows,'" then "picking" the road up to a depth of 4 inches, removing all the chalk, clay, or mud, breaking the largest stones small, and simply putting them back again, and one of his directions to his workmen was that "nothing is to be laid on the clean stone on pretense of binding." But too often the road was so bad, as at Egham, that it had to be removed to its foundations.

For the repairs of his roads, when once made, he always chose wet weather, and "loosened the hardened surface with a pick" before putting on the first broken stone; things familiar enough to us now, but paradoxes then to all the confraternities of the roads. In this way he had the greatest success with the freestone near Bath, and on a road out of Bristol toward Old Down, where everybody had always said a good road never would be made with the material available. This impossible road of 11 miles, which the postmaster-general, as a last resource, was about to indict, he perfected in 2 months, in 1816, for £55 ($275) a mile. Indeed, as to materials, they were to some extent a matter of indifference to him, provided they were stones and stones only.

Even in the breaking of the stones Macadam made a revolution. He saw that able-bodied men standing up with hammers wasted the greater portion of their strength. He made his stonebreakers sit, so that all the force of the blows took direct effect on the stone; and the result was that he found small hammers did the work perfectly well, and thus was able to confine it to old men past hard labor, women and boys, which reduced the cost of the broken stone by one-half. The size to which the stone should be broken he determined in a practical way by the area of contact of an ordinary wheel with a smooth road. This he found to be about an inch lengthwise, and therefore he laid it down that "a stone which exceeds an inch in any of its dimensions is mischievous," that is to say, that the wheel in pressing on one end of it tends to lift the other end out of the road. In practice he found it simplest to fix a weight of 6 ounces, and his surveyors carried about scales to test the largest stones in each heap. He would allow no large stones even for the foundation of his roads, for he found that they constantly worked upward by the pressure and vibration of the traffic. The whole road was small broken stone, even over swampy ground.—St. James Gazette.

From practical experience extending over many years as a member of a highway board having charge of about 25 miles of heavily trafficked road, we are able to say that the application of the principles of road making and repairing laid down in the above article will secure a perfect highway. We worked upon the system invented by Mr. Macadam, using both hand broken and machine-broken stones, and either a heavy horse roller or a steam roller, and made and maintained roads over which upon steep grades one horse could haul a ton in a cart weighing from 1,200 to 1,500 pounds with ease. The state of the roads made in the manner advised, may be judged from

the fact recorded a few days ago in England, that at the recent contest for the championship of the world on a bicycle on the highway, the winner rode in a direct line 336 miles in 24 consecutive hours.—ED.

In constructing a new road, Macadam usually did it in what he termed "three times." He first placed a layer of broken stone 4 inches thick, which was worked until it was set, when another layer of about 4 inches of broken stone was added, which in turn was worked until it was set, when the last layer of broken stone was added.

As to the kind of stone used, the whinstone seems to have been Macadams' favorite, followed by flint, limestone, and pebbles. Burgoyne, in his "Construction of roads," published in 1860, says:

The most important quality in stone for road making is toughness; mere hardness without toughness is of no use, as such stone becomes rapidly reduced to powder by the action of the wheels. Those stones which have been found to answer this purpose best are the whinstones, basalts, granites, and beach pebbles. The softer descriptions of stone, such as the sandstones, are not fitted for this purpose, being far too weak to resist the crushing action of the wheels. The harder and more compact limestones may be employed; but generally speaking, the limestones are to be avoided in consequence of their great affinity for water, which causes them, in frosty weather, which has been preceded by wet, to split up into a pulverulent state, and destroys the solidity of the road.

It is extremely difficult to arrive at the first cost of construction or that of repairing and keeping in good order the roads of this country, as I fail to discover any reliable data on the subject. The labor employed at this class of work is, and has been of the cheapest kind. Criminals have also been largely employed for this purpose. At stone breaking, women and children are still employed. During times of depression, workmen out of work are often employed for as low as 36 cents and 61 cents per day, at stone breaking and road repairing. The men employed at this work regularly are paid from 61 cents to 73 cents per day.

An approximate estimate of the cost of keeping in repair country roads would be from 3 cents to 5 cents per superficial yard. The probable cost of construction of new roads, irrespective of the value of the land, would be from 49 cents to 73 cents per superficial yard.

Tollgates.—The roads in England were until recently under the control and management of certain bodies called turnpike trusts or trustees, who were usually appointed by acts of Parliament applying to separate and distinct districts. Under these acts the turnpike trustees were authorized to collect from the drivers of all vehicles or from persons traveling on horseback, small sums which were called tolls. These tolls were collected in the highroads at various points at a tollhouse, being a small two-roomed cottage erected close up to the road, where a tollgate was fixed. This gate was a five-barred gate which was kept locked, and opened for each passenger on payment of the toll.

These tollhouses would in some districts be from 4 to 5 miles apart, and in others would be within much shorter distances, as the traveler

happened to get on the roads governed by different trustees. These tolls were for a two-wheeled vehicle generally about 6 cents each, and for a horseman 2 cents or 3 cents. Each person paying the toll received a small ticket marking the toll, and the toll paid in some instances freeing the passenger for a gate further on the road. In some districts tolls were very much higher than in others.

A friend tells me that he remembers once driving through Wales in a two-wheeled vehicle, perhaps about 25 years ago, when he was surprised to find all the roads in splendid condition, but the tollgates were very numerous, being met with in every mile or so, and rates ranging from 14 cents to 30 cents each toll.

These tollhouses had their bright side. They were usually pleasant breaks on a long journey, and many has been the agreeable chat with the old toll-keeper, who could usually spin a good yarn, and the fact of the tollhouse being there was often a protection to travelers on a long journey.

In Dick Turpin's (a famous highwayman) historical ride from London to York, about 200 miles, he may be remembered as having cleared a good many of the tollgates without stopping to pay the toll. As to these tolls there were certain persons who were exempt from payment of them, viz: Horses or carriages attending or going to attend queen or sovereign; horses employed in husbandry; vehicles conveying materials for mending the road; persons going to or returning from church or a funeral within the parish; ministers attending service; officers with prisoners. Also no toll to be taken for simply crossing the road or going 100 yards upon it. Also cattle, etc., going or returning from pasture.

These turnpike trusts were done away with by act of Parliament passed in 1878, known as the highways amendment act (41 and 42 Vict., c. 77) after which in the course of a very short space of time the old tollhouses gradually disappeared.

Under the act of 1878 and subsequent acts of Parliament it is provided:

First, the duty, maintenance, etc., of the highways is cast upon the ratepayers of the parish and managed by their highway surveyor.

Second, parishes are united into districts for the common object, under the supervision of the highway boards.

Third, municipal boroughs and towns have powers conferred upon them to perform the duties of highway surveyors within their boundaries.

Lastly, the central authority, the local government board, London, is intrusted with a general superintendence of the several systems for the benefit of the nation at large.

In order to raise the necessary funds for the maintenance of the highways the rateable property value in each parish is ascertained, according to the valuation list in such parish, or if no valuation list be in force,

by the justices of the peace, subject to appeal at the quarter sessions.

The surveyor is empowered to inspect any of the rates towards the relief of the poor, or the books of the assessment, and is allowed to make copies and extracts. The surveyor is to levy a rate upon all property rated, to the relief of the poor, and he has the same powers as the overseers of the poor for the recovery of the rate, and if it is not paid he can issue a summons for its recovery before the magistrates of the district.

No highway rate by any parish at any one time is to exceed 10*d*. (20 cents) in the £1 ($4.86), and the highway rates required to be paid in any one year are not to exceed 2*s*. 6*d* (61 cents) in the £1 ($4.86), except with the consent of four-fifths of the ratepayers of the district, procured at a meeting specially called. Property is assessed in England according to the rental value, and not on its full value, as in the United States.

RIGHTS OF BICYCLISTS.

(Suggested by the by-laws of the highways act, 1878, 41 and 42, Vict. C. 77, for the use of county commissioners of highways.)

In these by-laws the expression "bicyclist" means a person riding or otherwise using a bicycle on any highway.

A bicyclist shall not ride his bicycle upon any footway, pavement, or causeway set apart for the use of foot passengers.

Every bicylist who rides a bicycle during the time between one hour after sunset and one hour before sunrise shall have attached to his bicycle a lamp, so placed as to afford adequate means of indicating the approach of such bicycle.

Every bicyclist who overtakes any wagon, cart, or other carriage, or any horse, or any foot passenger proceeding along the carriage way, shall, when within a reasonable distance before passing such, by sounding a horn, bell, or whistle, give audible warning of the approach of his bicycle.

Every bicyclist who overtakes and passes any wagon, cart, or other carriage, or any horse, shall keep his bicycle to the right or off-side of the road.

In every case where a bicyclist meets or overtakes any horse which may become restive, such bicyclist shall take every reasonable precaution, to the best of his judgment, by dismounting or otherwise, so as to avoid danger.

Any person who breaks any of the foregoing by-laws shall be liable for any one offense to a fine of not exceeding two pounds ($9.73).

VALUE OF HIGHWAYS.

I have been unable to obtain any data showing "the effect of improved public highways upon land values and other economic conditions," for Great Britain. It is however safe to say that land values are improved, and that every branch of agriculture, commercial, and manufacturing industries is materially benefited through the operations of

good public roads in this country. There can be no question but that the great industries owe much of their development and prosperity to the excellent public roads. Horse power is vastly utilized by them, and the general comfort of the individual is increased. In short the public and private advantages resulting from the good roads are incalculable. Much may be said in favor of the old mode of maintaining the roads by means of the tolls, as the expense fell upon the persons using the roads, but it will be clearly seen that as this country (England) is small and thickly populated with large towns in close proximity to each other that the system now in force of having the rate payers of each parish bear this expense, is by far the most expedient and preferable. This system, however, in my opinion would have to be very much modified in its application to the construction and maintenance of public roads in the United States.

JOHN JARRETT,
Consul.

UNITED STATES CONSULATE,
Birmingham, Feb. 13, 1891.

ENGLISH STREETS AND HIGHWAYS.

REPORT BY CONSUL WIGFALL OF LEEDS.

MISCELLANEOUS STATISTICS.

An abstract of returns of turnpike trusts round about London for the year 1818 shows a length of road 210 miles 489 yards, under twelve distinct organizations, under acts of Parliament of various dates from the seventh to the fifty-eighth years of the reign of George III. The amount of tolls during the year named was £97,482.18.9 ($474,400.72); the amount of expenses, £93,856.0.6 ($481,082.85); and the outstanding debt, £62,658.7.0 ($304,926.86); or, per mile, tolls, £464.4.0 ($2,259.03); expenses, £470.14.0 ($2,290.66); debt, £298.7.0 ($1,451.92).

Such a statement is perhaps its own sufficient comment.

From a condition like that presented by these figures it is not far or difficult to conclude a course of administration the reverse of satisfactory. And that indeed was the fact. Too minute a subdivision of interest with its accompanying irresponsibility of control had wrought something closely approaching to ruin in the English system of public roads.

The elder McAdam, in his remarks (edition of 1822), refers to the amendment of a large proportion of the turnpike roads and some improvement of the parish roads as having occurred since the publication of the early editions of his essay. The fact that the reformation had not been more extensive and successful was, in his opinion, attributable

to the error still persisted in by trustees of continuing the services of persons as road surveyors who, he says, are not only altogether ignorant of the business they profess, but full of prejudices in favor of their own erroneous practice.

Six years' experience the author says has served to confirm his belief that the supervision of commissioners over surveyers is altogether ineffectual; whether for direction in their active duties or for protecting the funds of trusts (as the turnpike organizations were designated) from waste and peculation. The commissioners were unpaid and irresponsible, and the work done under their nominal authority and direction was correspondingly defective. England alone was parceled out "into 955 little trusts," which by dint of their numerous smallness had sunk into very low credit. The debt was at that writing seven millions sterling and promising to increase.

The modes of making and repairing roads were various in the different portions of the kingdom, being to a certain degree affected by the varying supply of materials. Gravel in the London neighborhood; flint in Essex and Sussex; in the west, limestone; in the north and in Scotland, whinstone, and in Shropshire and Staffordshire, pebbles mixed with sand. Excellent roads, Mr. McAdam states, may be made of any of these materials.

The London gravel mixed with clay and lacking angular points of contact whereby broken stone unites and forms a solid body, was found the least desirable. With proper treatment, however, even this would make good roads. Flint is called an excellent medium if due attention is given to the size. Limestone makes a smooth and solid road, consolidating sooner than any other material, but is not the most lasting. Whinstone is the most durable of all, and makes roads comparatively good and cheap. The pebbles of Shropshire are hard and do well for roads. The Scottish roads, though made of the best materials, were termed the most loose, rough, and expensive roads in the United Kingdom.

The form of road is objected to by the author, particularly the roads about London, high in the center of the way and making a dangerous slope except just in the middle of the road. Loose gravel was deposited in the center and left to work its way outward.

A road well made, it is said, will be easily repaired. Hence the necessity of intelligent supervision in the outset. Mr. McAdam continues:

> Will it be deemed presumptuous to propose that some regulations may be adopted for encouraging and promoting a better system of making roads, by eliciting the excretion and by creating a set of officers of skill and reputation to superintend this most essential branch of domestic economy?

The duties of an active executive officer are reckoned to include direction of repairs and alterations, control of contracts, and general superintendance of employés, and supervision of the accounts. A stint

of, say, 150 miles, it was thought, would give such an officer full occupation. He adds:

> Skill and executive labor must be adequately paid for, if expected to be constantly and usefully exerted; and if so exerted the price is no consideration when compared with the advantage to the public.

He is explicit in condemnation of statute labor for the maintenance of roads. He says it was decreed when no better means could be devised, at a time when a circulating medium was deficient and labor in many parts was hard to get for money. "Personal labor for a public service can never be made profitable or fairly productive." A commutation of statute labor for a moderate assessment in money was accordingly commended, and had then been effected in Scotland in most if not all of the turnpike acts by the local powers.

The insufficiency or improvident expenditure of the funds provided for by Parliament was proven by the numerous applications for extension of powers and increase of tolls. In the session of 1815 thirty-four such petitions, and in 1816 thirty-two, were presented and passed as a matter of course.

Mr. Macadam goes on to say:

> The defective state of the roads, independent of the unnecessary expense, is oppressive on aggriculture, commerce, and manufactures by the increase of the price of transport by waste of the labor of cattle and wear of carriages, as well as by causing much delay of time.

The author says he has abstained from any notice of the parish roads, although their condition and the state of their funds are more deplorable than that of the turnpike roads. He adds that the legislation on their behalf is so inadequate that they may be considered as being placed almost out of the protection of the law. They should be aggregated with the turnpikes and placed altogether under proper scientific and expert management.

An interesting extract from a Parliamentary report in 1811 contains the following statement:

> The many important advantages to be derived from amending the highways and turnpike roads of the Kingdom need hardly be dwelt upon. Every individual in it would thereby find his comfo rts materially increased and his interest greatly promoted. By the improvement of our roads every branch of our agricultaral, commercial, and manufacturing in dustry would be materially benefited.

Mr. Thomas Telford, before a committee of Parliament in 1819, said that the roads in England and Wales were in general very defective, both as to their directions and inclinations, being often carried over hills which might be avoided by passing along the adjacent valleys; that the inclinations were inconveniently steep and long continued, and specifies some previously existing conditions of grade as one in six, seven, eight, nine, and ten, with a width of 12 feet, without protection on the lower side, and the roadway itself improperly constructed. These had been corrected, and at the time the sharpest grade on the

road referred to was 1 in 17 for about 200 yards; another was 1 in 22 for a considerable distance, unavoidable from the lay of the ground; but the general grades on this road after the improvement were less than 1 in 30, with 32 feet breadth of roadway on level ground, 28 where side cutting did not exceed 3 feet, and along steep and precipitous parts 22 feet, all within the fences.

Between Shrewsbury and London this road still made its way over many hills. Another instance cited was between Shrewsbury and Worcester, which consisted of nearly a succession of very high and inconveniently steep hills, although very easy inclinations might be obtained by passing along the side of the river Severn.

These roads were cited by Mr. Telford as typical of many other roads in the Kingdom, not having been selected as more particularly defective than others. He adds that the shape or cross-section and drainage are quite as defective as the general direction and inclinations. No attention to constructing the foundations; materials seldom sufficiently selected and arranged; promiscously scattered on the road, impeding the travel and lending aid to destruction; the roadway hollow in the middle; the sides incumbered with mud in banks 6 and 8 feet high. Such are the attributes of the British highways at the time. Since then but fifty years have passed, and mighty has been the change. The description which we have just been traversing has many features which might suit an essay on the facilities existing at the present moment in a large number of the United States. The heedless manner in which so frequently the routes are selected; the utter disregard of grade; the boundary of a cornfield given preference for location of the line of road to the plainest topographical necessity; the wretched pretense of drainage which only works the ruin of the roadbed. These, and a multitude of similar reflections, may find analogy in the spirited complaint put forth fifty years ago in England.

The most important element in the problem seems to be the one which in the discussions of that and later periods has been so urgently insisted on in England, viz, the employment of competent expert capacity to personally and immediately supervise the designing, locating, constructing, and maintaining of the highways of the various country-sides. In even the remotest districts, destitute of facilities for exterior supply of road-making material, and where the natural resources of the country do not furnish it, there is still, and here even more perhaps than in more favored regions, the necesssity for skill and trained capacity in road building. A well-planned, scientifically executed line of highway, judiciously graded, sufficiently drained, properly protected from rain and flood, and systematically supervised and kept in repair, might well offer facilities, even with a roadbed of the native soil unmetaled, superior for traffic to the heaviest accretion of stone, unskillfully disposed and left by neglect to decay. It is prominently apparent in any fair consideration of the subject that competent special

ability in the selection of the route, in the management of levels, in the application of material, and in the unintermitting care of the roadway after it is built, is the essential and indispensable requirement for the proper development of our road system. No natural advantages can take the place of intelligent use of the means actually in hand.

The same irresponsibility, the same lack of individual personal interest and trained capacity on the part of those charged with the management of the English road systems in former times is now working its evil effects in our own States. Organization, liberal and coincidently judicious outlay of money, and expert supervision are vital needs in this connection.

Mr. Thomas Codrington, general superintendent of county roads for South Wales, a recognized authority, in his "Maintenance of Macadamized Roads," edition 1879, begins his preface by a statement that his subject is one upon which the published information in England is remarkably scanty. He speaks of the engineers of the Ponts et Chaussées in France as having been foremost in inquiries of this sort, and adds that the results of their labors are fortunately for the most part as applicable in England as in their own country. The lack of knowledge in England as to systematic road maintenance he considers will become more apparent in consequence of the then recent legislation by which half the cost of repairing the main roads had been made to fall upon the county rate, with the inferable consequence of supervision by the county authorities.

Application of new materials, prevention of avoidable wear by keeping the surface and the body of the road in good condition, removal of detritus as it forms, care of the surface and attention to drainage, are the points suggested as important. Four horses doing the work of five or three the work of four are results to be attained by proper management of the roadways, accompanied by saving of wear and tear of harness and vehicles. But actual economy in cost of maintenance generally he thinks follows as well. A good road is cheaper as well as better than a bad one. He speaks of upwards of £4,000,000 ($19,466,000) being spent annually on the roads of England and Wales, this expenditure being nearly all on macadamized ways. It is also exclusive of the London district, where macadamized roads are debited with £280,000 ($1,362,620) annual outlay. A large saving is reckoned possible on this, given more system and skill in administration; while the indirect economy in cost of drought and wear and tear is reckoned would probably far exceed the direct, considerable as the latter might be; so essential does this judicious writer deem the employment of expert superintendence. And the same text which Telford and Macadam expounded sixty years before has kept its vitality to this later day.

Telford and Macadam, while coincident in their aims, seem somewhat divergent as to method. The prominent point of difference in their theories would seem to have consisted in their requirements as to the

shape and size of the metal constituents used in the roadbed. The one held favorably the use of a bottoming of more or less symmetrically shaped stones of appreciable size set in careful order and forming a substantial foundation wherever was to be arranged the mass of smaller stones to make the surface of the way. The other assumed an antipodal position, and held that no foundation was so good as the native soil, handled, and shaped, and drained, where possible, but preserved from any sort of contact with stones of individual importance, size, and weight. These he deemed to be absolutely mischievous to cause injury to the stability of the working stratum of the road. This plan was uniformity of size (6 ounces in weight was his standard), and the stone distributed without mixture of earth, clay, chalk, or any matter which will imbibe water and be affected by frost; nothing to be applied for "binding." Broken stone, he says, will combine by its own angles into a smooth surface beyond the attack either of weather or wheels. Placing stone under the road to make it artificially strong enough to bear heavy carriages, though the subsoil is wet, and to try thus to avoid harm of water penetrating the soil, he says, has led to most of the defects of British roads. Strata of stone of various sizes will cause constant working up of the largest stones—uniform size from the bottom he holds to be the only remedy. He goes so far as to say that a road over a morass lasts much longer than when made over rock, citing in this connection the road between Bristol and Bridgewater, as showing a comparison of five to seven in favor of the wearing on the morass where the road was laid upon the naked soil against a part of the same road made over rocky ground. The thickness of the road he deems immaterial so far as regards its strength for carrying weight. The subsoil, which is kept dry by the road acting as a roof, bears the load as well as the road. He insists upon dryness to facilitate this effect. The morass of his illustration would seem, therefore, to have been a sort of dry morass.

Mr. Codrington thinks that this difference between the two engineers has been more dwelt on than the similarity of their systems on many other points in which they varied so widely from the practice of their predecessors. Both, for example, insisted on the necessity for the thorough drainage of the seat of the road (previously quite neglected) and both made use of materials broken to gauge to form a solid hard surface of a uniform cross-section and of curvature just sufficient to throw the rain-water freely to the sides. Telford's description is quoted:

> This foundation is a regular close pavement of stones carefully set by hand, and varying in height from 8 to 6 inches, to suit the curvature of the road. These stones are all set on edge, but with the flat one lowest, so that each shall rest perfectly firm. The interstices are then pinned with small stones, and care is taken that no stone shall be broader than 4 or 5 inches, as the upper stratum does not bind upon them so well when they much exceed that breadth. The pavement thus constructed is quite firm and immovable, and forms a complete separation between the top stratum of broken stones and the retentive soil below.

The French engineer, Tresaguet's, mode described by himself in 1764, and adopted generally in France in 1775, is cited for comparison, and shows great similarity.

Mr. Codrington, in this connection, distinguishes between "a firm and regular bottoming" to separate the road metaling from the subsoil and "a pavement." In order to secure a dry bottom, and to avoid suffering the workable materials coming into contact with clay, Telford was willing to get the effect by almost any means available; and suggested gravel, sand, vegetable soil, or chalk as alternatives to bottoming stones; a requisite, whatever the medium, was that "this bottoming should be made perfectly firm and regular, so as to receive the top workable metal of equal thickness." Thus it is said, although he always advised a paved bottom when it could be laid, many pieces of road were made under Telford's direction without the paved bottom, with which his name has been associated.

Mr. Codrington is of opinion that where the bottom is soft and wet and the subsoil can not be laid dry by drainage, a bottoming of some sort is very desirable, and that stone will be often found the most economical as well as the most convenient medium if considerable strength is required. Three or 4 inches of broken stone laid on 6 inches of pitching consolidates, he says, much more quickly under ordinary traffic than the 9 or 10 inches of broken stone alone. Stone for bottoming may be of a quality unfit for metaling or building. Macadam's objection that large stones would work up, Mr. Codrington limits to those thrown down anyhow on to an undrained subsoil, as per the older roadmakers, but denies that it applies to a carfully pitched foundation, a bottoming of stones on edge. The plea that the metaling is "ground to powder" between the wheel and the underlying pavement has been made, but sufficient thickness of metal is thought to obviate this danger. On a soft subsoil, where a pitched bottoming is most useful, experience is said to prove that the broken stone may be reduced by wear to 1½ or 2 inches in thickness without such action.

Mr. Codrington attributes a good deal of exaggeration to many of Macadam's statements. He deems it quite contrary to other experience that materials should last longer on a soft bottom, and says the morass road may have worn well in spite of its foundation and not because of it; and, he adds, that the saving in wear of materials on what he terms "a flexible road" could only have been obtained at the expense of increased draft of vehicle. He also takes exception to the theory of satisfaction from imperviousness to water alone, without reference to weight-carrying power advanced by Macadam. He goes so far as to say that while a water-tight covering, as in limestone roads, is desirable, roads of silicious material, though always more or less permeable, may be also very good. Modern practice, he says, varies from Macadam's precepts in other points; but the principle of broken stone laid directly on the natural soil has guided the construction of, by far,

the largest proportion of the roads of the present day, both in England and abroad. He gives Macadam the credit of first calling attention to the proper preparation of materials and the possibility of a road surface nearly impenetrable to water, though flat enough for vehicles over the whole area. To him also, he concedes, is largely due the establishment of a regular system of road maintenance under properly qualified surveyors. This alone would seem to entitle Macadam's name to high consideration in the country which has so benefited by his service.

ROAD CONSTRUCTION.

Regarding the construction of roads Mr. Codrington summarizes the subject under the following heads:

1. Drainage.
2. Cross section.
3. Road with a pitched foundation.
4. Concrete foundations.
5. Broken-stone road.
6. Breadth.
7. Water tables or side channels.
8. Outlets.
9. Foot path.
10. Fences.
11. Stone depots.
12. Rolling.
13. Use of a binding material.
14. Cost of macadamized roads.
15. Reforming an old road, and
16. Lifting a road.

(1) *Drainage.*—This is essential whether a paved bottom is laid or not. Ditches on each side of the road 2 or 3 feet deep are usually sufficient. They may be on either the field or the road side of the fence; better the latter if other things agree. They are easier of access and being nearer give more complete drainage. Where the road is below the level of the land the drains are often covered in. They should be under the side channel, 1 foot or so deep below the formation surface, and filled in with rubblestone to join with the road materials. Surface water should be otherwise provided for by open drains. If side ditches and drains are not enough miter drains must be added. These are drains meeting in a V in the center of the road and running to the side drains in the direction in which the road falls. One in 100 is sufficient inclination. They are cut in the formation surface 6 inches deep and 12 inches wide, filled in with broken stone. Drain pipes or box drains with side walls of dry stone and flat bottom and cover stone may be used. The latter have the advantage that they can be opened and cleaned. Care must be taken to tap and lead away springs rising under the road. Both the general highway and the turnpike acts give power to make drains through lands adjoining a road, with satisfaction for the damage. Draining is economy. A wet road is always troublesome. Ex-

pense in drainage is well expended. Culverts are required for surface water passing the road. Slight fall in these is best.

(2) *Cross section.*—Rain must be shed. A moderate inclination from the center to the sides will be enough, and best. Too great convexity throws traffic to the middle of the road. A flatter section distributes it. Fair surface makes water flow freely better than steepness. New roads more convex since the middle consolidates more by traffic, which is to be allowed for. Telford's section was a flat elliptical curve, differing slightly from an arc of a circle, by being more convex in the middle than at the sides. Walker recommended two straight lines following about 1 in 24 toward the sides and joined in the middle of the section by a curve. A common form is a elliptical curve, flatter in the middle than at the sides, which is apt to be too flat, though it makes good side channels, Either a flat ellipse like Pelford's or an arc of a circle is perhaps on the whole preferable. But regularity and evenness are more important than these slight differences. Six inches' fall from center to sides is enough for a 30-foot road and the fall should never go beyond 9 inches; for 18 or 20 feet breadth 3 or 4 inches is called enough. On a level road a rather rounder section is called for than on one with moderate gradients. On hills the side fall should lead the water off and prevent its following the surface along the lengths of the road. Water carried off a road by going down the wheel tracks is drainage misapplied. The side channels may be shaped to suit the bulk of water coming on them; but their tendency in being cleaned is to get deeper unless they are pitched.

The convexity of surface may be made either in the foundation or the road coating. Telford's practice was a level roadbed and convexity obtained by thinning both the pitching and metaling at the sides. On some parts of the Holyhead road the paved bottom on a level bed diminished from 7 inches at the center to 3 inches at the sides of a 30-foot road, then giving 4 inches fall in 15 feet on which broken stone was laid 6 inches in thickness for a breadth of 18 feet in the middle and thinning out from 6 inches to 4 inches in the 6 feet of width remaining on each side with 1½ inches of gravel over all, so that the finished road had a total convexity of 6 inches. On other parts of this road the paved bottom was laid over only 18 feet of the middle of a 30-foot road, diminishing from 7 to 5 inches in thickness with a layer of broken metal 6 inches thick over. On the portions without paved bottom the convexity was given partly in the gravel bottoming, 7 inches in the center and 2 inches at the sides of a 30-foot road, and partly in the top metaling of broken flint and large gravel which varied from 8 inches in depth in the middle to 4 inches at the sides with 1½ inch of binding gravel over all; thus giving 9 inches of convexity in the 30-foot width. Making the sides weaker than the middle is called, however, of doubtful utility in roads of ordinary dimensions. The sides are subject to heavy strains and need to be strong. An ordinary new road should have the roadbed shaped

to obtain the desired surface and at the same time to admit a uniform thickness of metaling, or only slightly thicker in the middle to allow for consolidation. This is thought advantageous also for dryness. The original surface should be undisturbed as far as possible, hollows being filled up from the adjacent ground rather than the elevations cut down. This particularly as to a clay subsoil. After getting into shape roller should be applied. Surface for metaling should be set out and shouldering to confine road materials be formed either in the solid or by sods backed up with earth. Outlets through the shouldering should be left for water from the road.

(3) *Road with a pitched foundation.*—Stones must be set by hand in close order broadest edge down and across the direction of the road. Laying flat gives a tendency to unsteadiness and the metaling does not bind so well. Upper edges should not exceed 4 inches in breadth. Inequalities should be hammered off and small stones packed in the interstices. Carts should keep off till the pavement has a coating of broken stone. This should be 3 or 4 inches deep for the first coat, and raked in the ruts while consolidating under traffic; and the remainder should be put on when the first is nearly set. With ordinary traffic 4 inches of broken stone over a pitched foundation should consolidate in about 3 months. Four inches of pitching and 4 of metaling are inside limits for thickness; 7 inches for pitching, and 6 for metaling mark the other extreme. In a level street a pitched foundation must fall near the gullies, or else the metaling will have to be too thin at the side.

(4) *Concrete foundations.*—Roman concrete 6 inches thick. Broken stone thereon 6 inches more. Upper surface of concrete indented to hold stone and drain off water. Annual wear of this reported $\frac{1}{2}$ inch. Common lime concrete also used, 6 inches thick; two layers of stone, 3 and 3 inches; the first laid before the concrete had set, which took in this stone, the upper layer after the first was partly consolidated by the traffic. Lias lime concrete also employed on Victoria and Chelsea embankments, 12 inches thick on slightly convex formation of surface stretching under the curbs of the footways. Six inches of granite in two courses, each rolled, was added after the concrete had thoroughly set; on a clay subsoil small gravel or sand 2 or 3 inches deep before the metaling is applied will cut off the clay. Chalk has also been used, but is called dangerous through effects of frost.

(5) *Broken-stone road.*—If a road is entirely of broken stone a layer 3 to 6 inches should be laid first and in dry weather. After consolidation begins add more, and so on till completed. Ruts require raking as soon as they appear. The layers after the first want wet weather. Too thick at first makes waste; but heavy traffic requires, especially with a soft bottom, a good thickness in the first layer. A new road needs rarely less than 6 inches for first layer. This on a good well drained road will serve a considerable country traffic. Macadam considered 10 inches of well consolidated material enough for any traffic on any sub-

stratum. Experience has proved this true in well drained and well kept roads even in London. Eight or 9 inches is usually enough; and gradually to apply by successive coats is better than putting on all at once.

(6) *Breadth.*—This should be enough to accommodate the traffic: 12 to 15 feet in country; 30 to 50 feet near towns. Fifteen feet permits two vehicles to pass. A few feet extra gives much relief. Hills render extra breadth desirable. Uniform breadth and well defined side channels are "neat and useful."

(7) *Water tables or side channels.*—Where the road abuts against banks or walls the slope near the meeting makes the water table or side channel. Usually, however, space exists on either side the metaled surface, and a sod or curbing should define the road and form the water table. Sods about 12 inches wide and 4 or 5 thick, 2 high, backed with earth, make a bank for a footpath or place for road scrapings, and is reckoned to cost 1*d.* to 1½*d.* (2 to 3 cents) per linear yard. Flat stones may be used for the water table, or asphalt made of gas tar, gravel, and road scrapings or other methods as to local circumstances.

Limestone curbs 1 foot deep and 4 inches wide are quoted 2*s.* 6*d.* (61 cents) to 3*s.* 6*d.* (85 cents) per linear yard. Granite curbs 12 inches wide and 9 inches deep, suitable for towns, cost 6*s.* 6*d.* ($1.58) to 7*s.* ($1.70) per linear yard.

In villages or where the road is bordered with houses a shallow gutter is more suitable; a slope to the road meeting the metaling in the line of the water table, which latter may be pitched or channeled. At junctions the channels require special attention, and cross drains may be used.

(8) *Outlets.*—Numerous outlets for water are necessary. It should not be allowed to stand. On hills outlets are specially required.

(9) *Footpath.*—If made it should be 9 or 10 inches above the water table and have a slope towards the road of about 1 in 30.

(10) *Fences.*—A post and rail fence is best because it does not shade the road. A bank and hedge are cheaper.

(11) *Stone depots.*—These are recesses to contain material for repairs. They should be near enough together to allow the roadmen to wheel out the materials to any part of the road.

(12) *Rolling.*—A new road should always be finished by rolling. The metaling is thus consolidated without the grinding and crushing by wheels of vehicles. Horse rollers are 3 to 4½ feet or more in diameter and 4 to 5 feet long, or of two or more cylinders side, by side, weight (not loaded) 2 to 3 tons. By loading a box or filling cylinder with water, weight may be increased for subsequent heavier work as the road consolidates. Pressure is desired to the extent of a ton to a ton and a half per foot width of roller, a 4-foot roller, 6 tons, requiring 6 horses. Horses feet tear the road if materials are loose and draft heavy. For superior work and economy steam rollers are preferred. A steam roller

weighing 15 tons, 7 feet wide, 2 tons per foot, compresses far more rapidly than a horse roller. It can do thoroughly 1,000 to 2,000 square yards of newly laid stones per day; 4 to 5 inches of stone may be rolled at once; thicker is better twice separately, in different coats. Any large stones or surface should be broken. Horse rollers go over several times unloaded, and hollows are filled with small materials. When the road begins to set the roller is partly loaded, and finally fully and until the stones are quite steady in place. A steam roller has all the weight at first. Artificial watering is necessary unless the weather is wet; 4 or 5 inches generally consolidate better than either thicker or thinner. Commence at the sides, and work to the middle. When the stones are thoroughly wedged together, but not before, binding must be added. This may be fine gravel, road scrapings, or sand. Chalky or clayey binding should be avoided. Limestone detritus is best with silicious materials and sand may be used with limestone road. Binding should be spread dry with a shovel, and uniformly, and worked in gradually with the help of watering and sweeping in addition to the rolling. As little as possible for effecting the purpose is best to use. The object is to consolidate the road, and the coalescing of the material of which its bulk is composed is to be sought for. The binding is only by way of supplement, and too much hurts the durability of the road. One quarter the bulk of the stones is sometimes used in France and one-sixth is the official proportion at Mandover.

(13) *Use of a binding material.*—Macadam and others have discountenanced the use of binding, but Mr. Codington thinks the proper use of it on a new road is founded on reason. It should be applied after the stone is laid, not mixed with it.

(14) *Cost of macadamized roads.*—This varies greatly. With materials close at hand a good road may be formed and coated for 1*s.* or 1*s.* 3*d.* (24 to 30 cents) per square yard, and a London street constructed in the best manner, with 9 inches of Guernsey granite, may cost as much as 6*s.* or 7*s.* ($1.44 or $1.68) per square yard.

The following particulars of the construction of roads near London are given from Sir James Macadam; time apparently about 1850:

For a road of the first-class, sufficient for a street with the heaviest traffic, 4 inches of gravel, riddled and broken so that no piece exceeded 3 ounces, was laid on a well-drained and prepared surface having a fall of an inch in a yard from the center towards the sides. When partly consolidated by traffic or by a roller, 2 or 3 inches more was laid, and over this, when sufficiently consolidated, 3 inches of granite or other hard stone. The furrows were kept raked, and the cross-section maintained in true form until the whole was consolidated, but no binding was used. The second-class roads required 4 inches of gravel and 3 inches of hard stone or granite; and the third-class 3 inches of gravel and 2 inches of granite or hard stone. Taking the gravel at 5*s.* ($1.20) per cubic yard, the drainage and preparation of the surface and spreading and raking, each at 2*d.* (4 cents) per square yard, a first-class road was estimated to cost 2*s.* 6*d.* (60 cents) per square yard. Granite is now (1879) 16*s.* to 18*s.* ($3.84 to $4.32) a cubic yard, and other prices are higher. In London streets, instead of the gravel, hard core, clinker, brick, or stone rubbish is now often used for the bottom 9 or 12

inches, over which 3 inches of Thames ballast is laid, and then the granite or hard stone, which is often thicker than 3 inches. The bottoming, the ballast, and the top metalling are generally now rolled separately, and the cost may be, as above stated, 6*s.* or 7*s.* ($1.44 or $1.68) per square yard.

(15) *Reforming an old road.*—The general objects should be the same as in making a new one. Drainage of foundation and surface, good and regular cross section, and sufficient strength, are the leading ideas.

Present condition is tested by sounding or digging small holes in the surface. Fresh material is to be added to a thin road, giving proper form, digging out and putting in, breaking unduly large stones, and side channels regulated. Mud and detritus must be sufficiently removed, and hollows filled up. Gradual improvement without unnecessary pulling to pieces should be the rule.

(16) *Lifting a road.*—A road sometimes contains enough or nearly enough material for its own reconstruction. The whole body is loosened with the pick. All stones over 6 ounces in weight, or which will not pass through a 2½-inch ring, are raked aside and broken to that gauge. After removing the large stones what are left are put in shape and the large ones broken up and spread on the surface. The surface may properly be lifted to 4 inches depth rather than altogether, as the bottom may be poor. Quarry rubbish or other dry material may be spread on the foundation before the stone taken out is replaced and fresh materials may be added. Two or three yards at one time is enough to lift. Macadam estimated lifting a rough road 4 inches, breaking stones, reforming surface, and cleaning water courses to cost from 1*d.* to 2*d.* (2 to 4 cents) per square yard lifted. A condition of road where there is plenty of stone, imperfectly broken, badly arranged and mixed with the soil, is one where lifting may be desirable. In many cases it would be unadvisable.

STREETS OF LEEDS.

The new streets in the town of Leeds are understood to be normally 12 yards wide. This is subject to numerous exceptions in the older parts of the borough, where width and directions are very irregular. The cost of paving is borne by the owners of property binding on the area paved. The average cost price of paving per lineal yard of boundary line, by which the assessment is laid, is reckoned to be something like about 25*s.* 4*d.* (see annexed schedules) ($6.08). The liability of the owner extends over half the area of his front, which is a street of normal width as above of 12 yards, would cover 6 yards to the front, making the lineal yard represent 6 superficial yards, and the corresponding cost per superficial yard on that average 4*s.* 2*d.* ($1.01).

As preliminary to making a new street, notice is posted of intended paving. This stands three weeks. This is understood to be warning

to the owner to begin and pave the street at his own cost and charges. The owner, however, sedulously omits compliance, and allows time to lapse. When five months have passed the corporation comes upon the field, and, having let a contract, proceeds to have the work completed; and having done so, and the job having undergone the necessary proof of fulfillment of the terms of the contract, the owner is amerced in the amount of the cost, each one proportionally to the length of his front boundary line. Details of contract are annexed in printed form, as also two *pro forma* tenders, giving approximate prices for the various items thereon set forth. One of these is for ordinary paving in accordance with the printed specification therefor above referred to, and the other is for macadamizing with specification pertaining thereto, also attached in writing.

There is another statement annexed to which special attention is invited, the estimate of 251 ($6.08), per lineal yard of a 12-yard street is a very general sort of average, and more accuracy can perhaps be obtained by collocation of the figures given on the *pro forma* tenders and Mr. Prince's statement, which is here referred to.

My hearty thanks are due to Mr. Prince, who is the highways surveyor of the borough of Leeds, for his interesting information.

LEEDS IMPROVEMENT ACTS.

Tender for paving, flagging, and leveling.

To the MAYOR, ALDERMEN, AND BURGESSES OF THE BOROUGH OF LEEDS:

—— the undersigned —— —— residing at —— do hereby offer to execute the various works required to be done in paving, flagging, and leveling ——, in the borough of Leeds, at the prices affixed to each item in the schedule hereunto written; to find and provide all materials necessary thereto, and all labor requisite for completing and finishing the same in the most perfect manner, to the entire satisfaction of Mr. Thomas Hewson, the engineer and surveyor appointed by the council of the said borough of Leeds, on or before the time mentioned in the specification, and according to the forms and dimensions, and upon the terms and conditions detailed and set forth in the drawing and specification deposited at the office of the said Mr. T. Hewson.

In case this tender shall be accepted —— do hereby agree to abide by and fulfill all the terms and conditions above mentioned, and to execute a contract in accordance therewith, and hereby propose Mr. —— —— of —— as surety for the due performance thereof.

Schedule above referred to.

The following prices include all materials, labor, all excavation or filling, and everything connected with and required for the completion of the various works hereinafter mentioned:

Description.	Prices.		
	English currency.		Equivalent in United States currency.
	s.	*d.*	
New flagging, 3 inches thick, of the best Riven Bradford or Idle stone, knotted on face, well squared through, and laid down in mortar, on a bed of ashes 4 inches in thickness, properly rammed and prepared for the same, including rising in brickwork set in mortar, window areas, coal places, and all other openings where the height is less than 6 inches, per superficial yard	4	2	$1.01
Old flagging: Taking up, removing, resquaring, and relaying in mortar, on a bed of ashes 4 inches in thickness, including rising in brickwork set in mortar, window areas, coal places, and all other openings where the height is less than 6 inches, per superficial yard	1	0	.24
New straight curbs, 12 inches deep, 7 inches wide, in length of not less than 3 feet, of the best Bradford or Idle stone, including chamfered edge, per lineal yard	1	10	.45
New circular curbs, 12 inches deep and 7 inches wide, in lengths of not less than 2 feet, of the best Bradford or Idle stone, including chamfered edge, per lineal yard	6	6	1.58
Old curbs taking up, rejointing, and refitting, including chamfered edge, per lineal yard	0	5	.10
New sets, from Bradford or Bingley quarries, 8½ inches deep, well squared through and laid in asphalt, on a bed properly rammed and prepared for the same, per superficial yard	6	6	1.58
Old sets, taking up, redressing, removing, and relaying in asphalt, on a proper bed, per superficial yard	2	0	.49
New paving stones in cubes not less than 6 inches each way, from Bradford, Bolton Wood, or Bingley, laid in asphalt, on a bed of ashes 4 inches in thickness, including road forming, excavating, and leveling, per superficial yard	4	2	1.01
Old paving: Taking up, redressing, and relaying in asphalt, on a bed of ashes 4 inches in thickness, including road forming and leveling, per superficial yard	1	9	.43
Brickwork, set in mortar, to area grates, coal places, and all other openings, where the height is above 6 inches and 10 inches thick, per square yard	7	0	1.70
Cutting hole in landing and rebating to receive coal plate, each	2	3	.55
Rebating and fixing flap door and ash-pit plates, each	3	0	.73
Rebating in window grates, with lead run in, complete, each	2	6	.61
Fixing area grates (new pattern), each	1	0	.24
Reworking old landings, per superficial foot	0	3	.06
Reworking old steps, per foot run of step	0	3	.06
Fixing steps, each	1	0	.24
New thresholds, steps, or trapdoor frames, wrought, per cubic foot	4	0	.97
Six-inch landings for cellar tops, etc., complete, per superficial foot	2	6	.61
Fixing old landings and making water-tight with cement, per superficial foot	0	3	.06

Dated this —— day of —— 188–.

(Signed) —— ——.

NOTE.—No claim under the contract will be allowed which is not made in writing and within one month from the final measurement.

Directions.– No tender will be received except in this form.

The blanks must be filled up and the tender must be signed and inclosed in an envelope, indorsed "Tender for paving, etc.," and must be addressed to "The streets and sewerage committee, town clerk's office, Leeds."

LEEDS IMPROVEMENT ACTS.

Specification of certain works that shall be done in paving, flagging, and leveling —— ——, in the township of ——, in the borough of Leeds, for the corporation of the said borough.

The works embraced under this specification are as follows, and shall be executed according to the drawings and instructions, and in every respect to the complete satisfaction of Mr. Thomas Hewson, the engineer and surveyor of the borough of Leeds.

Excavating and leveling.—The carriage ways and footways shall be carefully excavated, leveled, and formed to such level as shall be deemed by the borough engineer most convenient for the tenements abutting upon the street. The bed of the carriageway shall be made with a rise from the channels to the center of 1 in 30, and shall be cut out to a depth to allow a bed of 4 inches of clean, dry ashes, which shall be laid down to form the bed of the paving stones. The bed of the causeway shall be formed with a rise of 1 in 30, and shall be cut out to a depth that shall allow a bed of 4 inches of clean, dry ashes, which shall be laid down to form the bed of the flags. The superfluous earth or rubbish (if any) shall be led away immediately after completion of work. Should any hollow place require filling up, the same shall be done with dry and sound materials, well rammed. The price for doing all this work shall be included in the scheduled prices for paving, flagging, and curbing.

Paving.—The carriage way shall be formed of paving stones of the hardest stone, from the best beds in Bradford, Bolton Wood, or Bingley quarries, or of equal quality; entirely free from beds or flaws; in cubes not less than 6 inches each way, of uniform size, very neatly squared, and laid in regular courses from side to side, with fine cross joints, which must be kept perfectly clear to receive asphalt and coal tar-boiling hot; each stone must be laid with its natural bed in a vertical position; no stone will be allowed to be laid with its natural bed in a horizontal position on any account. The stones shall be well rammed, and all the joints shall be completely filled with a mixture of asphalt and coal tar, in approved proportions, run in boiling hot.

Curbstones.—The curbstones shall be of the hardest Nell stone, entirely free from beds and flaws, from the bottom beds in Bradford, Bolton Wood, or Bingley quarries, or of equal quality; they shall be 12 inches deep by 7 inches wide and not less than 3 feet long, and shall be firmly set on a solid bed in mortar. At the corners of the streets the flagging and curbstones shall describe a curve with a radius equal to the width of the footway. No circular curbstone shall be less than 2 feet long. The ends, tops, and sides of every stone shall be properly dressed and neatly boasted. When set the outer edge shall be neatly chamfered off for a width of an inch.

Channels.—The channels shall drop 4½ inches below the top edges of the curbstone, when the surface of the road has a natural fall to the gully grates; otherwise the channel must be constructed with a regular fall to take off the surface water which fall must be approved of before the channel is laid.

Flagging.—The flags of the footway shall be not less than 3 inches thick, of the best and hardest riven flags, knotted on face, from Bradford or Idle, or of equal quality, no dimension to be less than 18 inches. When the width of the causeway shall be 4 feet or less, every alternate course of flags shall go through the whole width. When the said width shall be more than 4 and up to 6 feet, not more than two flags shall be laid to every course; and where above 6 feet, they may be coursed two and three alternately. The joints shall be well broken in every case. All the flags shall be well squared, and the edges shall be properly squared through and dressed; they shall be laid in mortar on a solid bed of clean ashes 4 inches thick. No beddy flags shall be used.

Landings.—The landings shall be not less than 6 inches in thickness, of the best and hardest stone from Bradford or Idle, or of equal quality. When the width of the causeway shall be 5 feet or less, the landing shall go through the whole width, and it more than 5 feet, the landings shall be 3 feet square, if for a coal shoot, but if for cover to a cellar it must be the full width of the causeway. Each landing shall be properly squared, dressed, fixed, and made water-tight with cement.

Crossings.—The crossings shall be single sets of the hardest stone, entirely free from

beds and flaws, from the best beds of Bradford, Bolton Wood, or Bingley quarries, or of equal quality; laid down of widths corresponding to the footways. The sets shall be well squared and neatly dressed, not less than 8½ inches deep and 6 inches thick, laid in asphalt and tar, on a well-rammed, solid bed. The joints of the stones must be kept perfectly clear to receive asphalt and coal tar, boiling hot; each stone must be laid with its natural bed in a vertical position; no stone will be allowed to be laid with its natural bed in a horizontal position on any account. Two courses of inclined sets shall be laid parallel to the circular curb, so as to prevent any step in the causeway, and the crossing shall be so laid as to meet the level of the paved carriageway without break.

Brickwork.—The bricks to be machine made, of good quality, sound, well burnt, and sharp in the arrisses.

Mortar.—The mortar used throughout the work shall be composed of one part of the best Garforth quicklime to two parts of clean, sharp river sand, well mixed.

Asphalt.—The asphalt and tar shall be mixed in such proportions that the mixture shall, when cold, be tough and not brittle in any way, and shall be poured in boiling hot until the joints are well filled.

General conditions.

The contractor shall provide all implements and all materials (except only cast-iron work), and all labor of every kind necessary for the perfect completion of the works, and shall make good all damage done to water or gas pipes or other property in the execution of the works.

The contractor shall remove and cart away all the old paving, flagging, and other materials that shall not be allowed by the borough engineer to be relaid, or that shall not be claimed by the owners of property in the street.

The contractor shall remove all grates, taps, gutters, and other fittings at present existing in the street, and shall replace such of them as shall be suitable, and shall fix such new ones as shall be pointed out by the borough engineer. The iron work not refixed shall belong to the owners of property.

A rebate must be cut in the stonework to receive the front of all grates. The lugs to be let into stone-work and fastened with melted lead run in.

The contractor shall either always attend himself or shall employ a foreman, who shall be always upon the spot to direct the workmen; and the borough engineer shall have full power to discharge such foreman or any workmen should he or they disobey the orders of the borough engineer or conduct themselves in an improper manner.

The contractor shall provide a watchman and keep fires burning during the night in the said street, sufficient to protect the public effectually; and the said contractor shall be responsible for all accidents or damage which may occur at any time, either to person or property, in any way caused by any operations carried on in pursuance of his contract.

Wherever old paving, flagging, or curbing shall be found in the street that, in the opinion of the borough engineer, will suffice if relaid, the contractor shall redress and relay the same, as nearly as may be, in the same place.

The contractor shall distinctly understand that the works shall be throughout of the best materials and of the full sizes and thicknesses specified; and that the workmanship shall be first class.

The contractor shall give assistance in measuring up work, and net measurement only shall be taken, notwithstanding any local or other custom to the contrary.

No allowance will be made for rising window areas, coal places, and all other openings in the street where the height is less than 6 inches. The contractor must therefore carefully consider the nature of the work from inspecting the ground, and the plans and sections deposited at this office, before sending in his tender.

The contractor shall send in his tender upon the printed form supplied for this purpose by the borough engineer, as no other will be accepted.

Unskillful work or bad materials to be taken up and replaced.—If, at any period during the execution of the works, or within 6 months after their completion, it shall appear to the borough engineer that any work has been executed with unsound materials, or imperfect or unskillful workmanship, or if any repairs shall be considered necessary by the borough engineer during such period, arising from any sunk or damaged paving, flagging, curbs, or other works, that may occur from any cause whatever, whether arising from his own act, or the work of other parties, or of the workmen employed by the corporation, the contractor shall forthwith rectify, reform, and repair the same, in whole or in part, as the case may require, at his own proper cost and charge; and in the event of his refusing to do so, or to take back and remove any materials or articles which are considered by the borough engineer unsound, of bad quality, or not agreeable to the terms of the contract, and to provide immediately suitable materials in lieu of those condemned, within a period to be specified by the borough engineer, then the borough engineer shall have full power and authority forthwith to cause such imperfect work to be taken up and destroyed, and to employ other persons to alter or repair the same, and to supply the necessary materials thereto; and any expense thereby incurred shall be defrayed by the contractor, and may be deducted out of any moneys which may be due to him from the corporation, or may be recovered from him and his surety by the corporation (in the event of its exceeding the amount of moneys so due) as and for liquidated damages.

Bankruptcy of contractor.—That it shall be lawful for the corporation, in case the contractor shall fail in the due performance of any part of his undertaking, or shall become bankrupt or insolvent, or shall compound with his creditors, or propose any composition to his creditors for the settlement of his debts, or shall carry on or propose to carry on his business under inspectors on behalf of his creditors, or shall commit any act of bankruptcy, or shall not, according to the judgment of the borough engineer, exercise such due diligence and make such due progress as would enable the works to be completed within the time hereinafter mentioned, to determine the contract as far as respects its performance by the contractor, by a notice to that effect, in writing, but without thereby affecting the obligations and liabilities of the contractor, the whole of which shall continue in force as fully as if the contract had not been so determined, and as if the works subsequently executed had been executed by or on behalf of the contractor, and also without thereby creating any trust in his favor, and may enter upon and take possession of the works, and of all the plant, tools, and materials of the contractor, and use and sell the same as the absolute property of the corporation, and may proceed to complete the works, either by contract or otherwise, by engaging workmen and providing materials and implements, and may deduct the cost thereof from any sum or sums of money due or to become due to the contractor in respect of the contract, or recover the same by action at law or otherwise, as the corporation may be advised.

Disputes.—Any disputes which may arise during the progress of the works or at or after their completion, whether as to the meaning of the specification, or the materials, workmanship, or any other matters whatsoever relating to this contract, shall be referred to the borough engineer, whose decision shall be final, conclusive, and binding both on the corporation and the contractor.

Payments shall be made to the contractor by installments, as follows: When work to the value of £100 has been completed, 90 per cent. of the amount shall be paid within 1 week after the borough engineer shall have certified to that effect to the streets and sewerage committee of the council of the borough of Leeds; and so on by installments of not less amount until the whole be completed. The remaining 10 per cent. shall be paid after 6 months from the date of the last certificate, provided the borough engineer shall certify to the next ensuing meeting of the streets and sewerage committee aforesaid that the works are then in complete repair to his satisfaction, but not otherwise. The borough engineer shall have the power to refuse to grant a

certificate at any time, if the works are not progressing, being executed, or being put in repair, to his satisfaction.

Time.—The works shall be commenced as soon after the contractor's tender is accepted as the borough engineer shall order and, shall be completed within —— weeks after the said order has been given.

Penalty.—The penalty for noncompletion within the specified time shall be at the rate of £5 sterling for every week, or part of a week, that the specified period shall be exceeded.

THOMAS HEWSON,
Borough Engineer.

LEEDS, ——, 188—.

LEEDS IMPROVEMENT ACTS.

Tender for paving, flagging, and leveling.

To the MAYOR, ALDERMEN, AND BURGESSES OF THE BOROUGH OF LEEDS:

——, the undersigned, —— ——, residing at ——, do hereby offer to execute the various works required to be done in paving, flagging, and leveling —— in the borough of Leeds, at the prices affixed to each item in the schedule hereunto written; to find and provide all materials necessary thereto, and all labor requisite for completing and finishing the same in the most perfect manner, to the entire satisfaction of Mr. Thomas Hewson, the engineer and surveyor appointed by the council of the said borough of Leeds, on or before the time mentioned in the specification, and according to the forms and dimensions, and upon the terms and conditions detailed and set forth in the drawing and specification deposited at the office of the said Mr. T. Hewson.

In case this tender shall be accepted —— do hereby agree to abide by and fulfill all the terms and conditions above mentioned, and to execute a contract in accordance therewith, and hereby propose Mr. —— ——, of ——, as surety for the due performance thereof.

Schedule above referred to.

The following prices include all materials, labor, all excavation or filling, and everything connected with and required for the completion of the various works hereinafter mentioned:

	Prices.		
	English currency.		Equivalent in U. S. currency.
	s.	*d.*	
New flagging, 3 inches thick, of the best riven Bradford or Idle stone, knotted on face, well squared through, and laid down in mortar, on a bed of ashes 4 inches in thickness, properly rammed and prepared for the same, including rising in brickwork set in mortar, window areas, coal places, and all other openings where the height is less than 6 inches per superficial yard	4	2	$1.01
Old flagging, taking up, removing, resquaring, and relaying in mortar, on a bed of ashes 4 inches in thickness, including rising in brickwork set in mortar, window areas, coal places, and all other openings where the height is less than 6 inches, per superficial yard	1	0	.24
New straight curbs, 12 inches deep, 7 inches wide, in length of not less than 3 feet, of the best Bradford or Idle stone, including chamfered edge, per lineal yard	1	10	.45
New circular curbs, 12 inches deep and 7 inches wide, in lengths of not less than 2 feet, of the best Bradford or Idle stone, including chamfered edge, per lineal yard	6	6	1.58
Old curbs, taking up, rejointing, and refixing, including chamfered edge, per lineal yard	0	5	.10
New sets from Bradford or Bingley quarries, 8½ inches deep, well squared through and laid in asphalt, on a bed properly rammed and prepared for the same, per superficial yard	6	6	1.58
Old sets, taking up, redressing, removing, and relaying in asphalt, on a proper bed, per superficial yard	2	0	.49
Macadam, per superficial yard	2	8	.65
New paving stones in cubes not less than 6 inches each way, from Bradford, Bolton Wood, or Bingley, laid in asphalt, on a bed of ashes 4 inches in thickness, including road forming, excavating, and leveling, per superficial yard			
Old paving, taking up, redressing, and relaying in asphalt, on a bed of ashes 4 inches in thickness, including road forming and leveling, per superficial yard	1	9	.43
Brickwork, set in mortar, to area grates, coal places, and all other openings, where the height is above 6 inches and 10 inches thick, per square yard	7	0	1.70
Cutting hole in landing, and rebating to receive coal plate, each	2	3	.55
Rebating and fixing flap door and ash-pit plates, each	3	0	.73
Rebating in window grates, with lead run in, complete, each	2	6	.61
Fixing area grates (new pattern), each	1	0	.24
Reworking old landings, per superficial foot	0	3	.06
Reworking old steps, per foot run of step	0	3	.06
Fixing steps, each	1	0	.24
New thresholds, steps, or trapdoor frames, wrought, per cubic foot	4	0	.97
Six-inch landings for cellar tops, etc., complete, per superficial foot	2	6	.61
Fixing old landings, and making water-tight with cement, per superficial foot	0	3	.06

Dated this —— day of ——, 188—.
(Signed) ——— ———.

NOTE.—No claim under the contract will be allowed which is not made in writing and within one month from the final measurement.

Directions.—No tender will be received except in this form.

The blanks must be filled up, and the tender must be signed, and inclosed in an envelope, indorsed "Tender for paving, etc.," and must be addressed to "The streets and sewerage committee, town clerk's office, Leeds."

SPECIFICATION FOR MACADAMIZING.

Form a ballast foundation, clean hard rubble pitching from approved, Potternewton or Woodhouse quarries, 12 inches thick in center and 9 inches thick at sides of road.

The pitching must be hand-packed on edge, the thickest and broadest end of stone laid downwards.

On this foundation form a layer of hard, clean broken stone, 3 inches thick above the general level of ballast. The stones to be broken to pass a 2½-inch gauge; carefully roll until firm, then lay top cover of best Threlkeld or other approved granite, 6 inches thick in the center of the road and 4 inches at the sides, well and evenly broken to pass a 2-inch ring, neatly formed to curve of road; the whole must then be thoroughly rolled with a steam roller. (The highways committee will grant the use of their roller, which must be paid for by the contractor at the usual rate.)

The rolling must begin at the sides and gradually proceed to the middle of the road. It must be accompanied by a water cart and all hollows that may appear on the surface as the rolling proceeds must be filled in with small stones, and the surface loosened for this if necessary.

When the stone is firmly wedged together, fine, clean, dry gravel, or dry macadam road sweepings must be spread with a shovel uniformly over the surface in small quantities, and must be thoroughly rolled into the road with the aid of watering and sweeping, fresh binding being added as that first applied works in or is found necessary.

The crown of the road when finished must be not less than 3 inches above the curb level.

Form the channel 18 inches wide of courses of best Bradford or Bolton sets, 8 inches deep, laid and set on a bed of screened engine ashes, 6 inches thick, the whole to be well squared, and neatly dressed and run with boiling asphalt until the joints are entirely filled.

The following is the statement previously referred to as received from Mr. T. A. Prince, highways surveyor, borough of Leeds:

INFORMATION AS TO ROADS AND STREETS IN THE BOROUGH OF LEEDS.

Materials used for paved streets of heavy traffic: Granite sets 6 inches deep, 7 to 8 inches long, 3 inches wide. These sets are in every case laid on a bed of cement concrete 9 inches deep. Cost, complete, of concrete paving and granite sets, about 14*s.* per superficial yard ($3.41).

Materials used for paved streets of light traffic: Gritstone pavors obtained from quarries in Yorkshire. Size, 6-inch cubes laid on a bed of ashes only. Cost of paving complete, about 4*s.* per superficial yard (97 cents).

Cost of making macadam roads for heavy traffic, with granite broken to a 2¼-inch gauge purchased by the corporation from the various granite companies in England and delivered by the said companies at the various railway stations as required, and afterwards carted by the corporation from the said stations to wherever required throughout the borough, is about 2*s.* 11*d.* per superficial yard (71 cents).

Cost of making macadam roads for light traffic with limestone or dross broken to a 2¼-inch gauge is about 2*s.* per superficial yard (49 cents).

Entirely new streets are sewered, paved, and flagged at the cost of the owners of property on each side of the road and afterwards declared public highways and maintained by the corporation forever out of a uniform highway rate assessed throughout the borough.

In a majority of cases throughout the borough flagged footways are laid on each side of the road. The total width of these footways is one-third of the full width of the road, *i. e.* a 36-foot road equals two 6-foot causeways and 24 feet of roadway.

Cost of curbing per lineal yard, about 3*s.* 2*d.* (77 cents).

Cost of flagging per superficial yard, about 4*s.* 3*d.* ($1.03).

In making an entirely new macadam road we pitch the foundation to a thickness of 8 or 10 inches and afterwards put on a covering of metal about 7 inches thick.

Supervision.—In Leeds there are close upon 300 miles of paved and macadam highways, the management of which is under one central department.

We have eight outdoor inspectors who have under their charge a staff of men numbering from 20 to 30. These inspectors overlook nearly 40 miles of highways, and their duties comprise the looking after the men, the putting on of materials, and the rolling of the same.

Experience has proved that in numerous cases within the borough of Leeds whenever a new road has been made or an existing road widened and improved the value of the land adjoining the same has wonderfully increased.

With regard to the country roads within the borough of Leeds there are very few which have not the footways properly formed with curbstones and channel.

F. H. WIGFALL,
Consul.

UNITED STATES CONSULATE,
Leeds, December 10, 1890.

BIRMINGHAM.

REPORT BY CONSUL JARRETT.

CITY STREETS.

In the city of Birmingham there is something over 200 miles of public streets, of which 7 miles have the carriageways paved with wood, about 24 miles with granite, and the remainder are macadamized.

For the wood-paved streets 3-inch by 6-inch creosoted yellow deal blocks are used, being laid on a 6-inch bed of Portland cement concrete. In the construction of these roads care is taken to have the ground dry and firm before the concrete is laid on. A very thin coat of cement or a mixture of cement and clear sand is placed over the concrete so as to have the surface perfectly even, which is left to stand for several hours and when dry the blocks of wood are finally laid on, over which heated pitch or a mixture of heated pitch and tar is thrown so as to fill up all the crevices between the blocks.

The first cost of these at present is about $2.68 per square yard. The Improved Wood Pavement Company (a London corporation constructing this kind of road throughout Great Britain) maintain these roads whereon there are not any tramways (street railways) for 1 year free of charge and for 20 years thereafter at prices varying with their situation from 15 cents to 18 cents per square yard per annum. On tramway routes the company is paid at a rate of 24 cents per square yard per annum for maintenance between and for 21 inches on either side of the metals, the first cost remaining the same.

For granite-paved streets, Leicestershire or Carnarvonshire sets 3 inches in width by 6 inches in depth are generally used, being placed on 6 inches of Portland cement concrete. In the construction of these roads great care is taken to have the foundation good and firm. The first cost of these is about $2.92 per square yard. The repairs for the first 7 years are practically nil, for the next 7 years from 6 cents to 14

cents per square yard per annum. In the heaviest traffic streets the paving would probably then require relaying at a cost of about 73 cents per square yard, when it would last under similar conditions another period of 14 years, and the best of the stone might be then redressed and used in second or third class streets, and the remainder be broken up and used for macadamizing purposes.

It will be observed that the first cost of construction is very large when compared with the cost of relaying with new blocks. This is due to the great care taken in preparing the roadbed for the blocks in the first case. Such a roadbed may last, if properly constructed, for a very long period. I have very carefully investigated the matter but have not yet found a single case in which granite blocks are placed on a bed of loose sand or gravel, which is so commonly done in the United States. First cost may be heavy in this country but cost of maintenance, it will be observed, is comparatively very light.

Then there is the advantage of good, even roadways, over which the heaviest loads are easily and conveniently conveyed. I have seen breakdowns on the streets of this city through overloading or defective axles, but so far have not seen wheels of wagons stick in a hole between granite blocks or between blocks and the metals of the street railways.

For newly made macadamized streets, assuming that the ground has been roughly formed, about 9 inches of ashes are required over which 8 inches of either gravel or broken slag, is placed and over this again is placed 6 inches of broken rowley rag stone which is obtained about 7 miles outside the city. Large heavy iron rollers are then passed over the stone surface. During this process water is applied, and about an inch of clean gravel is worked into the surface.

The first cost of such roads may be taken at about 73 cents per square yard. The maintenance thereof varies very much according to the traffic, and it is found economical to substitute pavement for macadam if two coatings of stone are required annually.

JOHN JARRETT,
Consul.

UNITED STATES CONSULATE,
Birmingham, February 13, 1891.

HULL.

REPORT BY CONSUL DANIELS.

GRANITE PAVEMENTS.

Granite and wood pavements and macadamized roads are used in this city and district. The work is done by contract under the direction of the borough engineer.

In granite pavements the surface for the foundation is formed parallel with the finished surface of the road and at the required depth below

the same. The foundation of the carriageway extends under the curbs and channels and consists of a layer 7 inches in thickness of cement concrete, composed of clean broken brick, stone, or coarse gravel, of such size as will pass in any direction through a ring 2½ inches in diameter, together with such quantity of other suitable fine material as will make up the interstices, and Portland cement in the proportions of one of cement to eight of the other materials. The whole to be well and carefully mixed with the proper quantity of water, the materials being hacked gradually down and watered on a platform, and being turned over at least three times in such process.

Existing foundations are utilized when suitable, all loose material being removed from the surface when necessary by the addition of fresh concrete. The whole surface of the foundation is covered to a depth of from 1 to 2½ inches as required to level the surface, with fine concrete as a bed for receiving the sets, which are laid while the concrete is soft, and must be well bedded therein, and no greater area is covered at one time than can be easily paved before the same has set.

The sets are carefully sorted out and selected as nearly as possible of equal depth, so as to run in parallel courses, the entire width of the roadway and the courses are arranged throughout so that the sets in each course will break joint well and evenly with those in the adjoining courses, and the sets are placed close end to end; the closing as well as the commencing stones adjoining the channels and tramways, if any, being alternately long and short. The courses are laid as close as possible together, the joints at no point exceeding ¾ inch in width.

Great care must be taken to adhere to the camber, and all necessary templates must be used to secure this. The rammer must be used as little as possible, and any set above or below the required level must be taken up and reset. When the fine concrete has set hard, the interstices in the paving must be well raked in full to the top with small, clean shingle of good quality, free from sand and perfectly dry, and as soon as possible after the joints have been filled with shingle, they must be run up full to the top, while dry, with asphalt, which is composed hereof coal-tar pitch and thick boiled coal-tar, from which the spirit has been extracted, in proper proportions, the whole boiled together for such a period as may be necessary to cause the mixture to set hard and stiff when cold, without being brittle, and to be whilst hot, sufficiently fluid to fill all the interstices in the shingle. No joints are run with asphalt until the laying of the pavement has been approved by engineers. As soon as the asphalting of the joints is completed, the whole surface of the pavement must be covered evenly and uniformly with approved dry gravel, which must be laid on before the asphalt is quite set, so as to become partially bedded therein. The crossings are paved in a similar manner with sets provided for the purpose.

WOOD PAVEMENT.

In wood pavement, which gives much satisfaction in this country, a foundation of cement concrete is formed, 7 inches in thickness, composed as described in granite pavements.

Its surface is faced with half an inch of cement, mixed in the proportion of one measure of cement to three of sand, formed to the proper camber and inclinations, and smoothed so as to form an accurate bed for the wood blocks.

The blocks of wood are sawed die-square from redwood, 9 inches by 3 inches by 5 inches, the grain of the wood running with the 5-inch measurement, and equal to the samples deposited for inspection. After the blocks are cut up, the contractor must give notice to the engineer in order that he may inspect them, and when the engineer has approved them, they must be creosoted with 12 pounds best creosote to the cubic foot.

Two courses of wood blocks are laid parallel to and adjoining each curb, and the remainder in courses running transversely to the street, and the blocks in the courses are placed close end to end, those adjoining the channel being long and short in alternate courses.

The courses themselves are three-eighths of an inch apart, the proper distance being maintained by laths laid on the cement. The joints are filled up with shingle to a level of 1 inch below the surface, and run up with asphalt, as for set pavement, to such level, care being taken to allow no asphalt to run over the surface of the blocks.

The remaining inch of the joints is run up with cement-grout mixed in the proportions of one of cement to two of sand, and the whole surface is then covered with fine gravel.

MACADAMIZED ROADWAY.

The surface for receiving the foundation material for macadamized roads is formed parallel with the finished surface of the road and at the required depth below the same.

Where the existing surface is raised the material must, if required by the engineer, be watered and rolled or rammed.

The foundation of the carriage way consists of a layer of hard chalkstone or other material accepted by the engineer, 8 inches in thickness, broken into sizes not exceeding that of a 4-inch cube, and into smaller pieces on the surface as required to fill the interstices, and properly rolled, and such layer is to extend under the channels and curbs. The next coating consists of a layer of granite, or other suitable material, broken to pass in any direction through a $2\frac{1}{2}$-inch ring, of a thickness before being consolidated of $2\frac{1}{2}$ inches, and such coating to be rerolled until set. The coating is to be formed to a proper camber, making the crown, in the case of a roadway 24 feet wide, 1 inch above the curbs.

The surface covering consists of a further coating of whinstone,

broken to pass in any direction through a 2½-inch ring, of a thickness before being consolidated of 2½ inches, such coating being covered with gravel and rolled in a similar manner to the previous one.

As to maintenance, a paved road is repaired in a similar manner to that in which it is first made.

A macadamized road in town is hacked over, spread with a sufficient quantity of broken whinstone to raise it to its proper level and camber, and rolled with a steam roller, just sufficient binding material being used to fill the interstices in the larger material. The binding material generally used is a somewhat loamy gravel.

On country roads the old surface is not hacked over, nor is the new material rolled, but is left to be consolidated by traffic.

SYSTEMS AND COST OF ROAD MAKING.

The roads are under the control of the city or borough engineers. As the same staff also deal with drainage and architectural work, I found it impossible to separate the office expenses chargeable to highways.

PUBLIC EFFECTS OF IMPROVED ROADWAYS.

I have not been able to get sufficient information which would enable me to give a satisfactory reply to this query.

BYRON G. DANIELS,
Consul.

UNITED STATES CONSULATE,
Hull, December 30, 1890.

LONDON.

REPORT BY CONSUL-GENERAL NEW.

As directed in Department's circular, dated November 8, 1890, I have the honor to submit herewith a report upon the subject of the streets and highways, and of their construction and maintenance in this consular district.

I am fortunate to be able to obtain and inclose herewith the reports of William Haywood, esq., engineer and surveyor, to the honorable commissioners of sewers of the city of London, for the years 1873, 1874, 1877, and 1882, upon the condition of the streets and pavements of the city of London.

The streets and pavements of the city of London are under the control of the commissioners of sewers, and Mr. Haywood has been their engineer and surveyor in charge for many years.

I was also fortunately able, through the great kindness of William Weaver, esq., engineer and surveyor to the vestry of the parish of St. Mary Abbotts, Kensington, to obtain from him a most able and full and

elaborate communication upon the merit of the various kinds of streets and pavements under the charge of that vestry, which includes that part of the metropolitan London called Kensington; and I wish to acknowledge to that vestry their very great kindness, and to Mr. Weaver my sincere thanks for his most valuable communication.

I also inclose herewith the thirty-second and thirty-fourth reports to the vestry of St. Mary Abbotts, which include much information upon the subject in hand.

I also inclose a valuable communication from James R. Heward, esq., surveyor, etc., to the board of works of the Greenwich district of the city of London, upon the subject, together with printed copies of the specifications for making the various kinds of streets, pavements, and roads in that district.

From these reports and communications may be learned the original cost of the various kinds of pavements used in London, as also the annual cost, through a series of years, of the maintenance of the several kinds, and another valuable report on the accidents to horses and vehicles upon each kind of street in the varying conditions of the weather.

These reports, being authentic and official, and made as those are by these eminent engineers of so many years' practical experience and observation, are vastly more valuable and reliable than would be a report made by a non-expert in such matters, and, I believe, fully answer the inquiries of the circular so far as my immediate consular district is concerned.

I desire to express herein my thanks to these several gentlemen for their great kindness in providing these reports and communications.

JNO. C. NEW,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
London, January 3, 1891.

THE STREETS OF LONDON.

Mr. Weaver, chief engineer and surveyor, to Consul-General New.

TOWN HALL, *Kensington, December* 15, 1890.

SIR: The Kensington vestry at its meeting on the 10th instant considered your letter asking for certain information on the subject of roads, and issued a general instruction to their vestry clerk and surveyor (myself) to furnish you with information on the subject.

In obedience to the instructions above referred to, I hasten to discharge my part of the reference.

Your letter to me of the 5th instant specified four heads of information, and I proceed hereunder to deal with them in the order of your enumeration, prefacing my remarks by pointing out that the information hereinafter set forth is of a general character, susceptible of detailed treatment to an almost unlimited extent, but involving in such elaborated treatment an amount of labor impossible of bestowal within the limits of the vestry's instruction.

I now proceed to deal with the several heads of information.

(1) The methods employed in making and maintaining public roads in Kensington.

There are about 84 miles of roads in Kensington paved with wood, asphalt, pitching, broken granite (macadam), flints, and gravel. All the main roads are paved with wood except about 1,000 square yards of asphalt. The whole of the wood paving is laid on a foundation 6 inches thick of concrete composed of Thames ballast and Portland cement mixed 6 to 1. This foundation is sufficient, provided there is a good solid substratum beneath; where such solidity does not exist extra concrete should be provided. The concrete is worked to a perfectly smooth face, and when hard set the wood blocks are laid thereon in transverse rows. Over 200,000 square yards of wood have been laid in Kensington, and I have tried various kinds of wood, including the ordinary fir deals, beech, vale, and jarrah, cut to depths varying from 3 to 6 inches, and have laid the blocks in a variety of ways close together, with open joints grouted with different materials, with felt joints laid on asphalt and on felt, plain deal blocks, creosoted blocks, naphthalized blocks, etc., etc.

The figures and details appertaining to the various experiments in this one description of road work would make a good-sized pamphlet, but the result to the present time in Kensington is that we are laying down creosoted deal blocks 9 inches by 3 inches by 5 inches deep (on concrete as aforesaid) generally with open joint three-eighths inch wide, filled with asphalt to a depth of one-fourth or one-half inch, and remainder of joint grouted in with Portland cement grout. Sometimes the wood is laid close without any joint, and if the weather (dry) permits this to be done the result is good. The success of creosoted wood depends upon the quality of the creosote and the thoroughness of the creosoting. By the method I employ this is assured. My table of results shows about 10½ pounds of creosote forced into each cubic foot of wood laid.

Herewith I have forwarded copies of my two last annual reports, and you will see therein (amongst other information which may be of service) that the greater part of the wood laid is 6 inches deep.

Of late years, however, 5-inch blocks have been used and in one thoroughfare, Sydney place and Onslow square, 4-inch blocks have been laid down, and it is very likely that a few years hence blocks deeper than 4 inches will not be used. The object of reducing the depth is to save the great waste of wood when the road is repaved. With 6-inch blocks there is about 3 inches of wood wasted consequent on the necessity of repaving, when 3 inches of the contour of the road has been worn away, as the side channels, unaffected by traffic, retain their original levels.

A road wood-paved with 5-inch creosoted deal blocks will last 10 years, and at present prices will cost 1*s.* 6*d.* per square yard per annum for first cost and reparation throughout that period; the concrete included in the first cost will remain as an unencumbered asset to be taken over for the next term. The first cost of excavating for and providing concrete foundation may be taken at 3*s.* per square yard.

Scavenging is not included in foregoing cost of maintenance.

In my opinion wood paving is at present the best paving for the main roads of a district such as Kensington. In a nonresidential commercial district, such as the city of London, I should give the preference to asphalt, which can be laid at a first cost of about 11*s.* per yard, or laid and maintained for 15 years at an annual cost of about 1*s.* 6*d.* per yard, but the price would vary according to traffic.

The essential requirements of wood and asphalt paving is cleanliness—thorough cleansing. Washing and sweeping every night, if necessary, and the prompt removal or picking up of horse droppings during the day. One of the great difficulties is the removal of the sludge formed on wet days. This I effect by wide india-rubber squeegees, the slush being forced into large iron gully pits under channels and cleaned out and carted away during the night. In Appendix A you will find this iron gully (which I designed) described, and I may add that since the date of that report the said gully has proved so successful that I have extended their use considerably.

With reference to pitched roads in Kensington, this paving is almost exclusively confined to mews, stable yards, and tram lines. Mews are generally paved with 4-inch by 4-inch cubes on 6 inches of concrete; tram lines with 6-inch by 3-inch pitchers on concrete, and pitched roads for heavy traffic with 9-inch by 3-inch pitchers on concrete. The greater dimensions of the pitchers represent the depth of the stone.

Without doubt the most durable road is one formed of granite pitchers. The great objection to their use is the noise. For heavy traffic roads, with steep gradients, pitching is the best and most economical road paving, especially if granite tram-wheel tracks are provided.

With regard to roads made and repaired with broken granite, flints, and gravel, it is essential in the first place to provide a good foundation. My specifications always provide for a consolidated foundation 18 inches thick of good brick rubbish or hard core, and spread thereon a consolidated coat 9 inches thick of Kentish flints or gravel (as the case may be) or of broken granite. With the last-mentioned material a consolidated coating 4 inches thick will generally suffice. The consolidation is effected by steam rolling. I use broken granite of various descriptions, broken to various gauges, 1¼ inches to 2¼ inches, using the smaller gauge in light carriage roads and the larger in roads traversed by omnibuses. In my opinion, the most pleasant road to travel upon and easiest to maintain is a well-formed gravel road; but, of course, this kind of road is out of the question beyond a certain traffic point.

(2) The details of the systems followed and expenses incurred respecting same.

I take it that a great deal of the information embodied in the answer to question No. 1 will also apply to this question. In addition I may add that the work of making new roads (of all kinds) and the supply of all materials for the reparation of existing roads, is executed and carried out, under specifications prepared by me. Tenders are invited by advertisement for the new work as it arises, and for the supply of materials, annually. The maintenance, scavenging and watering, is executed by the vestry's own staff, consisting of about 450 men, 100 horses, and about 150 carts and wagons. All the carts, etc., are made in our own workshops, blacksmiths' and harness work is also performed by vestry's own men. The foregoing staff also performs the work of house refuse collection and removal. The house refuse (dust, ashes, etc.), and street refuse (mud and sweepings), amounts to about 100,000 tons annually. It is collected by the carts and deposited in barges on the river and Grand Junction Canal. In relation to this refuse the scheme of the vestry is to utilize it for agricultural purposes, and with this object, land at Purfleet (17 acres) has been acquired, but as this scheme is only just being entered upon, it is too early to form an opinion relative thereto, based on facts. I may add, however, that my views on this subject are not in accord with those of the majority of the vestry, and are set forth in the series of reports hereto attached in Appendix No. 2.

(3) The effect of improved public roads upon land values and other economic conditions.

This is a very wide question upon which I could write a very long essay, but speaking generally, it is beyond question that the formation and maintenance of good roads increases the value of land in a district and adds to the rental value of the houses. If the governing authorities of a town or district, by good management, make such district a nice comfortable place to live in, people will flock to it in added numbers, convert agricultural land into building land and increase the trade.

In 1856 the roads in Kensington maintained by the vestry, were 23½ miles in length.

The greater portion of the district was market-garden ground, now covered with mansions and houses from £100 to £1,000 a year rental value.

At the present time in Kensington there are about 84 miles of road maintained by the vestry; the population is 179,720, and the gross rateable value of the parish is £2,390,728 (net, £1,999,682).

Shops in the High street, then letting at £80 and £100 per annum, now command £500 a year, with heavy premiums.

This change has not, of course, *all* been brought about by parochial management. Proximity to the parks, etc., has had a good deal to do with the change, but the parks, etc., existed, I may say, for centuries prior to the change, and I am certain of this, that wealthy people will not continue to reside in a district where sanitary requirements are neglected, refuse allowed to collect in houses, bad roads provided for traveling, and neglected lighting, watering, and scavenging allowed to prevail.

(4) Such other information as may be germane to the general subject of improved public roads.

Under this head may properly be considered the questions of subsoil, and the rights of companies and others to lay mains, pipes, electric and telephone wires, etc.

The functions of the vestry in relation to road making commence as soon as vacant land is proposed to be laid out for building.

Formations of roads. (25 and 26 Vic., C. 102, S. S. 98 and 99; 45 Vic. C. 14, S. S. 7, 8, 9).—The first step in the transformation is to submit duplicate plans to the London county council, showing the road proposed to be formed or laid out and setting forth the widths and levels of same. One of the said duplicate plans is forwarded to the vestry for their opinion, which guides in a great measure the decision of the London county council. Under the 98th and 99th sections, 25 and 26 Victoria, Cap. 102, and the 7th, 8th, and 9th sections, 45 Victoria, Cap. 14, very full powers are conferred upon the Metropolitan board of works (now London county council) enabling them to control this initial stage of the development.

The council can refuse to sanction a street with a less width than 40 feet, or with less than two outlets; and by the increased powers given under the last-mentioned act, they can require the roads to be formed in such directions as to secure convenient intercommunication with adjoining roads. This power, although guarded by a proviso giving a right of appeal to a police magistrate, in order to check unduly arbitrary treatment by the council is an extremely salutary one, as it tends to prevent the isolation and locking in of estates to the detriment of the public convenience. Although in certain circumstances the council's powers may conflict with the right of the freeholder to do what he likes with his own land, still it is only just that the owner, in increasing some forty fold the value of his ground, should in some degree have to study the interests of the public, to whom the land owes its increment of value. Had this act been in force years back it would have prevented estates being laid out to the detriment of public intercommunication.

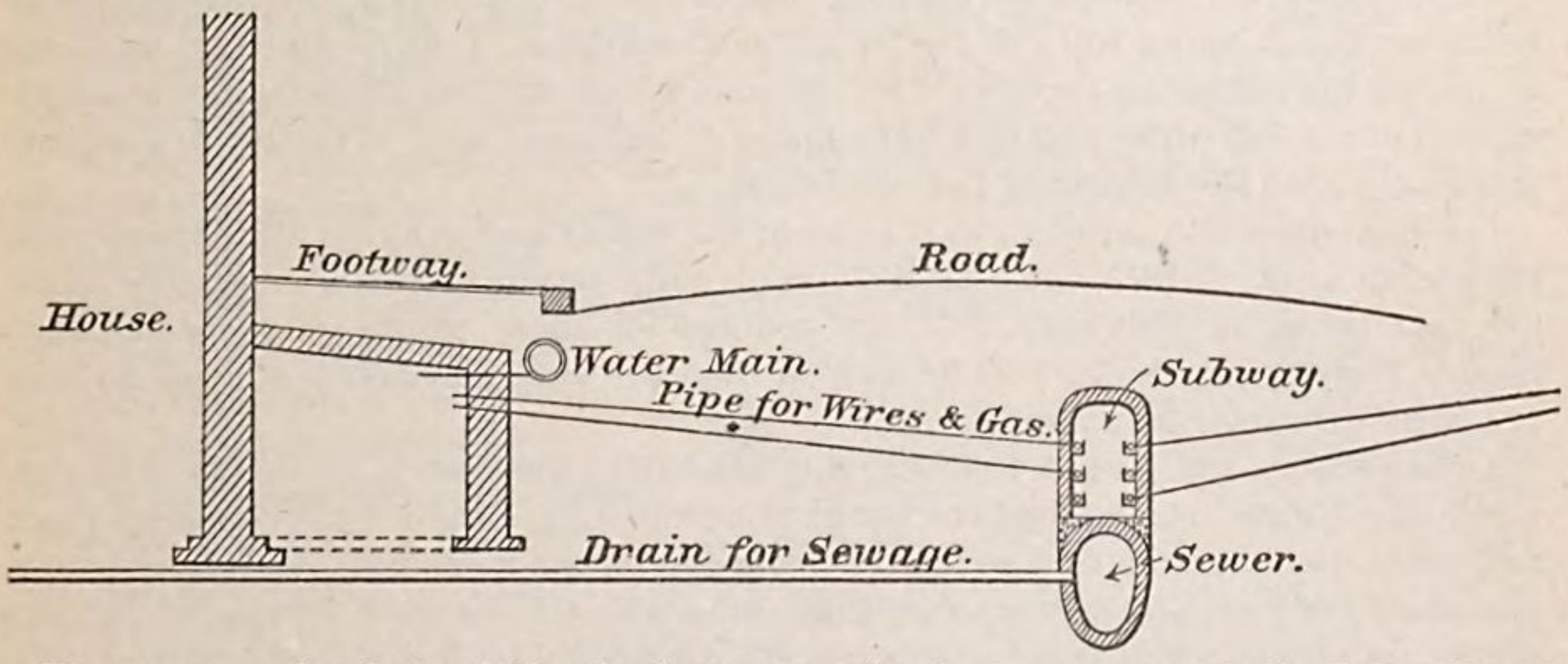
The plan of the proposed roads having been approved, the formal consent of the council is given, with the condition attached that no bars or obstacles to the free use of the roads by the public are at any time to be erected. This condition has only of late years been appended; but it is a most wise one, as it prevents the existing nuisance of gate-barred streets. A bill, seeking powers to abolish barriers now in existence, is before Parliament, and if enacted will confer great benefit, but doubtless will entail considerable public expense. Had the law, as it now stands, been the same in the past, this compensation for removal would not have to be paid.

The owner having obtained the approval of the council, who, at the same time, name the street, may proceed with its foundation, and now the anxieties of the surveyor to the local authority commence. If zealous in the discharge of his duties, he is desirous that the road shall be formed in such a manner as to be a safe and convenient highway for public traffic, and that it shall contain nothing concealed below the surface likely to jeopardize the health or safety of the future abutting residents, or the public passing thereover. He has in the first place to see that the full width is set out, and then that the proper level is observed. Very little difficulty arises on the first point, and the second question of level should have received full thought when the plan was before his vestry for consideration, as it is essential that new roads on one estate should be laid out at such level and incline as conveniently to intersect and join with other roads formed, or to be formed, on adjoining estates. The proper levels having been determined after due consideration, it only remains to

enforce them, and although the heights of all intersecting streets are set out by the vestry's surveyors, and the value of such heights above ordnance datum furnished to the builders, yet it is no unusual thing, upon the vestry proceeding to make up the street some year or two afterwards, to find the houses erected at different heights with an utter disregard of the intersecting levels furnished as aforesaid, leaving to the surveyor the interesting problem of how to adjust the paving and road levels to the varying heights of the areas and steps with the minimum of injury and disfigurement to the property. In clay lands I find the tendency is to make the roads too high; and in sand and gravel soils, too low. In the former the surplus clay has to be carted away at considerable expense, while in the latter every load of sand and gravel excavated means increased profit.

By the sixth section of the metropolis management act, 1890, the abstraction of subsoil is prohibited from the site of any road formed or proposed to be laid out, and no road is to be formed upon made ground, except under conditions to be imposed by the local authority, subject to appeal to the London county council. This new law will add materially to the stability of future roads, and to the safety of pipes, mains, drains, etc., laid in them.

Gas mains, electric light and telephone wires, I am of opinion should be laid in subways. In old streets, the initial outlay is the great hindrance to their adoption, but in forming new streets this difficulty to a great extent does not exist. By forming a subway over the sewer when it is being built the only extra cost is the brickwork; all the excavation is necessitated by the sewer, and by laying side pipes in the drain trenches nearly all the expense of the side connections is saved.



The water mains I should lay in footways. As the sewers are rebuilt, I should add the subways, and thus, at any rate within a 100 years, subways would be universal. If this process of gradual provision were deemed too slow or tedious, it might well be considered whether it would not be well to raise a "subway loan" to provide the capital expenditure. Taking such a loan at 3 per cent. for 50 years and the cost of subway at £10,000 a mile, I think it would be practicable to charge such a rent for its use as the companies would be glad to pay and such rent would repay the capital expenditure within the life of the subway. The public authorities would thus save the loss caused by the incessant disturbance of the highways, and the public themselves would be saved the inconvenience attaching to such incessant disturbance. With regard to above estimate of £10,000 a mile, the cost would be about half this amount if the subway was formed with the sewer.

Referring generally as to question No. 4, I would advise that the roads of a district should be made in relation to the traffic upon them, and paved with the most suitable material, having due regard to all the circumstances attaching to such road. In Kensington before any road is made up or converted, I submit a report and estimate which generally guides the vestry in its action.

With regard to your inquiry as to books of reference, I am sorry I can not help you in that respect. I have never studied books. I have gone about a good deal, and my

views, as hereinbefore set forth, are the outcome of 31 years practical experience, and if the information I have roughly tried to convey in a concise form does not prove too prolix for your patience, and does prove of some service to your department, I shall be well satisfied.

If you would like to see me, or desire further information, pray command

Yours faithfully,

WILLIAM WEAVER, C. E.,
Surveyor, Town Hall, Kensington.

General J. C. NEW,
Consul-General of the United States of America,
12 St. Helens Place, Bishopsgate Street, E. C.

STREET AND HOUSE REFUSE.

[Appendix to Mr. Weaver's report.]

PARISH OF ST. MARY ABBOTTS, KENSINGTON.

VESTRY HALL, KENSINGTON,
Surveyor's Department, March, 1880.

To the WHARVES AND PLANT COMMITTEE OF THE VESTRY OF KENSINGTON:

GENTLEMEN: In accordance with the directions of the vestry, instructing me to report on the slopping work of the parish of Kensington, I have prepared and beg to submit the following remarks. For reasons which will be obvious after a consideration of the following pages, I have found it necessary and advisable to deal conjunctively with the subject of dust collection.

The committee will recollect that prior to the vestry undertaking the execution of the parish work, in 1877, the cost of slopping and dusting had been increasing annually, and when in February, 1877, the tenders for these works were opened, such largely increased amounts were demanded that the vestry resolved at once to take the work into their own hands.

Acting energetically upon the foregoing resolution the vestry, on the basis of a report and estimate which I had the honor of submitting, obtained the necessary plant and premises, and from that period have carried on the work until the present time, in a much more satisfactory manner than under the old contract system, and at the same time at less cost. Owing, however, to causes hereinafter referred to, the work each succeeding year becomes more costly and difficult of execution, and unless prompt and effective measures are adopted, the time, in my judgment, is not far distant when the vestry will find itself in serious difficulties, with the present available means of escape therefrom then closed or only to be acquired at vastly increased cost.

With a firm conviction that a large amount of the present cost of work may be saved, and with the future difficulties of the work plainly apparent, I beg to submit and place on record the views I entertain with respect to the subject on which I am directed to report.

The accounts of the vestry for the past 3 years, during which the work has been performed by the vestry's own staff and plant, furnish only the total expenditure for the entire work theretofore executed under contracts and do not give the separate cost of any one particular branch thereof. It thus being impossible to ascertain the value per day of a horse and cart engaged on any one particular work, I have, in the subjoined statements, taken the value of the horse labor herein referred to; the totals given as the cost of the work must, therefore, be taken as comparative estimated amounts and not as actual totals of expenditure. The deductions and inferences, however, drawn from the rates and amounts tabulated, would be but very slightly altered by a reduction or increase of a shilling in the assumed rates per day.

STATEMENT I.—*Road sweepings.—Number of loads removed, amount of labor employed in removal, and estimated cost of same.*

During the year ending Lady Day, 1879:		
Number of loads removed		32,706
Horse, cart, and man, at 13*s.*, number of days		6,981
Total cost of collection and shoots	£5,290	19*s.* 6*d.*
Amount paid for shoots	£753	6*s.* 6*d.*
Net cost per load for collection and shoots		3*s.* 3*d.*
Average number of loads per day per horse and c art		4⅘
During 9 months ending Christmas, 1879:		
Number of loads removed		20,252
Horse, cart, and man, at 13*s.*, number of days		5,096
Total cost of collection and shoots	£3,467	9*s.* 9*d.*
Amount paid for shoots	£155	1*s.* 9*d.*
Net cost per load for collection and shoots		3*s.* 5*d.*
Average number of loads per day per horse and cart		4

STATEMENT II.—*Dust and ashes.—Number of loads, labor, and cost of collection.*

During the year ending Lady Day, 1879:		
Number of loads collected		25,567
Dust, cart, and dustman, number of days, at 14*s.* 9*d**		10,180
Gross cost of collection	£7,507	15*s.* 0*d.*
Amount received for dust†	£3,837	16*s.* 0*d.*
Net cost of collection	£3,669	19*s.* 0*d.*
Net cost of collection per load		2*s.* 10½*d.*
Average number of loads per day per cart		2⅓
During 9 months ending Christmas, 1879:		
Number of loads collected		19,914
Dust, cart, and dustman, number of days, at 14*s.* 9*d**		7,352
Gross cost of collection	£5,422	2*s.* 0*d.*
Amount received for dust†	£497	15*s.* 0*d.*
Net cost of collection	£4,924	7*s.* 0*d.*
Net cost of collection per load		4*s.* 11½*d.*
Average number of loads per day, per cart		2 7/10

As the committee have decided that the collection of dust can be performed more economically by having one dustman to two dust carts, rather than by having a dustman with each cart, in addition to the cartman, it assumed in the preceding statement that the whole of the carts have been worked on the preferential plan.

It will be seen on reference to the two statements, that nearly 60,000 loads of refuse have annually to be collected in the parish and carted away, a work of great magnitude, involving a heavy expenditure.

The cost of the work depends, in a great measure, on the distance to which the refuse has to be carted; for instance, if during the 12 months ending Lady Day, 1879, the slop carts had been enabled to deliver, on an average, 6 loads each per day, instead of 4⅘ (Statement I), a saving in that work alone would have been effected, amounting to £1,758, assuming that the shoot was the property of the parish, and the committee will perceive from the same statement that the net cost per load was 2*d.* less during this period, compared with the following 9 months, although the shoots were costing nearly four times more in the former than in the latter period.

During the same year (12 months ending Lady Day, 1879 (Statement II), the dust realized a large sum of money, an amount which it is not likely to produce in the

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*Horse and cart, ladders, baskets, tools, etc., 9*s.*; Carter, 4*s.*; Moiety of dustman's wages, 1*s.* 9*d.*; total per day, 14*s.* 9*d.*

†The dust delivered under agreement of sale is taken as all being paid for.

future. Leaving out, therefore, that exceptional time from this calculation, and taking the return for the 9 months ending Christmas, 1879, we have a total of 19,914 loads delivered, giving an average of $2\frac{7}{10}$ loads each cart per day. If nearer shoots had been provided, enabling the carts to deliver 4 loads each per day, a saving of £1,252 would have accrued upon the net cost, and calculating the saving during the remaining 3 months of the year at the same ratio, the total saving in the 12 months would be £1,670. This amount added to the reduction in slopping (£1,748), above referred to, gives £3,418 as the total amount which might be fairly expected to be saved in 1 year by the acquisition of handy shoots. Such saving, however, could only be effected on this important condition, viz, that the refuse, when once deposited, should not involve any further net expense to the vestry, but should, after its reception, be made at least to pay for itself.

This condition, which I believe can be more than fulfilled, necessarily leads up to the subject of the best means of disposing of and utilizing the refuse, in order that it may be made at least to pay for itself, and thus fulfill the condition referred to.

In the first place, a large amount of material has to be dealt with, viz, 60,000 loads per annum, which may be taken as over 90,000 cubic yards. The question, then, for consideration is the best method of dealing with 58,000 cubic yards of slop and road sweepings, and 40,000 cubic yards of dust and house refuse.

The road refuse consists of sweepings from—

First, macadamized roads; second, flint and gravel roads; and third, wood-paved roads.

The first mentioned is composed of particles of granite, more or less small, horse droppings, water, and litter. The particles of granite and horse droppings could be eliminated by screening the slop mixed with added water; the fine particles of granite-like sand would settle, and the water, almost clear, could then be drawn off for reuse. The first screenings, *i. e.*, granite and horse droppings, would be dried in an oven attached to furnace, hereinafter referred to, and the horse droppings separated therefrom. This latter material, would, I am of opinion, find a sale as a dressing for grass lands, but if not sold it could be burnt.

The flint and gravel road sweepings are composed of small particles of flint, with horse droppings mixed with water, and could, with added water, be passed through a screen of a mesh gauged to pass the flint grit and retain the horse droppings. After drawing off the water the flint settlings would remain and be very valuable for consolidating the macadam roads under the steam roller. With this binding material a road is better made than if sand is used, and does not give off so much slop. Every yard of this material used would represent a saving of 4*s*. 6*d*., and if such material was rewashed and passed through a finer screen the pure grit would fetch 10*s*. a yard.

The sweepings from wood-paved roads consist almost entirely of horse droppings, which could be sold as manure. The sweepings from Brompton Road, the committee are aware, now fetch £5 per barge load.

In the street refuse, the committee will therefore perceive that they possess valuable useful materials which they are now paying to get rid of, owing to want of storage space. Samples of all the component parts of the street refuse, as herein referred to, are herewith submitted.

The dust and house refuse is composed of breeze, dust, hard and soft core, and pickings, all possessing a market value, except the soft core, which would be burnt—a portion of the breeze forming the fuel.

The market for Kensington dust without doubt has, in the past, been spoiled by the inability of the vestry to hold over their stock, and the price for the same would go up on its being stored, and sold at such a rate as to make its own market. True it is that dust will be wanted as long as bricks are being made in the neighborhood, but so long as the vestry is without storage accommodation, the committee is at the mercy of the brickmakers, who have only to combine to dictate their own terms; but given the storage space, with the means of burning the soft core, etc., and the

positions are reversed, with the additional advantage of saving the labor now expended in carting the material long distances, a large part of it being not only of no use when it reaches its destination, but the cause of nuisances, which at any moment may place the vestry in the dilemma of having to collect the dust without having any place to shoot it.

The committee will perceive that the foregoing remarks all point to the desirability of the vestry acquiring depots within the parish for the receipt of the street and house refuse, and in addition to the direct saving resulting therefrom, as hereinbefore alluded to, I would point out other attendant advantages.

1st. The horses and men could be better supervised then when going to distant shoots, such as Acton, Fulham, etc., and the strictness of the supervision is inversely proportionate to the area of the work. There can be little doubt that a large proportion of the sickness and mortality amongst the vestry's horses is attributed to the distant shoots.

2d. A stock work would be provided for otherwise idle horses and men, whose unearned wages have now to be paid.

3d. The present shoots, costing a large sum for attendant men, chain horses, and road making, are only temporary; they are situated almost entirely in Fullam and Hammersmith, the board of works for which districts are just commencing the execution of their own work, and it is extremely unlikely that Kensington will be able, in the face of the extra carting involved, to offer better terms than Fulham for shoots within its own district, but outside ours.

4th. I would ask the committee to consider the equity of the question, whether it is fair for Kensington to send its offensive refuse into other districts, the authorities of which object to its presence, but perhaps are unwilling to take legal measures to stop its delivery. Acton, however, it will be remembered, did stop the delivery of our dust last summer.

5th. The neighborhoods now receiving the parish refuse are rapidly being built over, and in a short time will cease to afford shoots.

6th. The present distant shoots involve a large increase in the number of horses and carts, and proportionate increase in risks of working and increased cost of supervision. By having the shoots near the work a much smaller plant would do more work with greater efficiency, with the risks attendant upon bad roads, public water troughs, and unsupervised carmen, reduced to a minimum. Recently as many as 50 horses out of a stock of 84 have been employed in dusting alone, and that at a time when the slopping required extra strength, the lack of which entailed loss to the parish.

7th. The proximity of the depots would enable the horses to change carts quickly, a matter of much importance in the watering season, when through change of weather the horses have to be transfered from slop carts to water vans as expeditiously as possible. By the courtesy of the guardians of the poor we are allowed at present to stand carts, etc., at the stoneyard, potteries, a convenience liable, however, to be withdrawn at any time.

8th. By withdrawing a large number of carts, vans, etc., from the Pembroke Road depot, storage space would be given there, now much needed. At the present time, for want of room, I am often compelled to send material (other than street sweepings) to the shoot, which, if stored at the depot, could hereafter be used with economical results.

Each of the foregoing considerations are submitted in a condensed form only, but they are capable of being enlarged upon to a very considerable extent.

I beg, therefore, to strongly recommend that two depots be obtained; one in the north, and the other in the south part of the parish. In the northern depot pits could be excavated for the receipt of all refuse not sold, burnt, or utilized; the excavated clay being burnt into ballast worth 2*s*. 6*d*. per yard in the depot. Such material will be largely required in the north district during the next 10 years, and its value will increase beyond the price named, proportionately to the difficulty in obtaining it.

In the south district the depot would yield sand and gravel, worth respectively, at present 2*s.* 6*d.* and 2*s.* per yard on the ground, but these prices are going up every year.

As before mentioned, the only portion of the street refuse for which, at the present time, I am unable to show a profitable use, is the fine mud of the granite slope, remaining after the granite and horse droppings are removed. This mud, although consisting of minute particles of granite, would, as far as I am able to see at present, have to be buried; dealing with it, however, in this way, the ground excavated for its reception would if sand more than pay for the labor involved, and nearly so in the case of clay having to be got out, such material being converted into burnt ballast as aforesaid.

A furnace would have to be erected at each depot, with sifting and screening apparatus, and the ground, if sufficiently spacious, could be so laid out in inclines as to make a good deal of labor self-performed by gravitation. Disinfecting chambers might be economically erected in conjunction with the furnace, and the money now paid by the vestry for the disinfection of clothing, bedding, etc., saved.

I would here remark that several large towns—Manchester, Birmingham, Warrington, Blackburn, Derby, Leeds, Nottingham, and Rochdale amongst others—have acquired depots and erected furnaces for dealing with and burning their refuse, and it is well worthy of the vestry whether a small committee might not be appointed with advantage to this parish to inspect the operations as carried out in the towns referred to.

If the committee and vestry agree with me as to the advisability of acquiring depots as herein suggested, I would recommend that no time be lost, as land is daily increasing in value and becoming more difficult to obtain. In addition, I would advise that ample space be provided, as the work is increasing every year, and would, even at the outset, require a large area for sorting and turning over the refuse, and the excavations as filled in as before mentioned would not renew their virgin soil.

In the foregoing report I have endeavored not to exaggerate the expected future results, but rather to take the worst view of the question, for I am firmly of opinion that the committee would find, after a year's experience in dealing with the refuse of the parish, that a great deal of so-called refuse, now costing a large sum annually to get rid of, would, under skillful management, prove a large item of revenue.

According to the less sanguine view of the subject, the vestry can afford to spend £60,000 on the acquisition of suitable land for depots, and the erection of buildings, machinery, etc., and still save on the present annual expenditure; but looking to the future, with the increasing difficulties of the work, I should be afraid to state the sum which the vestry might, in my judgment, spend with advantage for this purpose.

In the foregoing paragraph £60,000 is mentioned as the sum which might be expended without increasing the current expenditure, but it is not intended to convey to the committee that that amount of outlay is needed—£35,000 would, I am of opinion, cover the entire expense.

I trust I am not out of order in stating that should the vestry deem me over confident as to the profits likely to accrue from dealing with the refuse in the manner herein suggested, I believe private individuals are ready to come forward and enter into arrangements with the vestry, whereby you might be relived of all trouble with regard to such refuse when once deposited.

In conclusion, I would remark that in the foregoing report I have confined myself to the scope of the vestry's reference, but should it be deemed desirable, I could now, with the experience of the past 3 years' execution of the parish work, founded upon my report of 1876, offer some suggestions relative thereto, which, I believe, would prove of value to the vestry; but inasmuch as such reports involve considerable time and labor, I have thought it right not to withdraw the necessary time from my other duties without the vestry directing me to do so.

I have the honor to remain, gentlemen, your obedient servant,

WM. WEAVER, C.E.,
Surveyor.

STREETS OF LONDON.

Mr. Heward, surveyor, to Consul-General New.

BOARD OF WORKS FOR THE GREENWICH DISTRICT,
141 *Greenwich Road, Greenwich, S. E., January* 1, 1891.

SIR: In answer to yours of the 8th ultimo respecting the cost of making and maintaining public roads in London, I take pleasure in sending the following answers to your questions, obtained from practical results extending over a period of nearly half a century:

(1) The methods employed under my superintendence are: (*a*) Land value on flint roads; (*b*) Macadamized or broken-granite roads; (*c*) granite-cube or set paving; (*d*) wood-cube paving; (*e*) asphalt.

I attach a specification, marked A, giving details for forming and making up new roads or streets, on which system land values or macadamized roads are constructed in my district, also a specification, marked B, giving details of forming granite-cube and wood-cube paving. Asphalt, although the more costly material at first cost, is the most cleanly and durable of any, but is not easily repaired after trenches made by gas, water, electric, and other companies, and is very treacherous under certain conditions of atmospheric changes for horse traffic. The foundation for an asphalt is made as for a paved road, with a 3-inch coating of asphalt in lieu of the granite cubes.

(2) Systems followed in repairing roads (*a* and *b*) by picking up the crust or surface to a depth of about 2 inches and coating same with material to a depth of about 2 to 3 inches, and the whole rolled solid, cost (*a*) about 1*s*. per yard superficial; (*b*) from 2*s*. to 3*s*. per yard superficial. The life of these roads depends entirely upon traffic and weather, but an average of 2 years might be taken.

The life of a granite-cube paved road is about 21 years, with an average expense for repairs of 6*d*. per yard superficial per annum.

The life of wood-cube paving is from 4 to 5 years, and the average expense per annum would not exceed 6*d*. per yard superficial.

Asphalt will stand from 15 to 20 years if left undisturbed.

(3) The effect of improved public roads upon land values depends entirely upon situation and traffic. Where heavy traffic has to be carried, and in large towns and cities, improved paving is found more economical and cleanly, but land values or macadamized roads are less costly and preferable in country or park roads, where traffic is of a lighter nature.

I trust this information is what you seek, but shall be pleased to answer any further questions you may wish, upon your application.

I have a book, "System of Road-Making," by John Loudon MacAdam, 1827, which I should be pleased to lend for your perusal. I can not part with same, as it was given to me by my tutor, Sir James MacAdam.

Yours, respectfully,

JAMES R. HEWARD,
Road Surveyor to the Greenwich District Board of Works.

JOHN C. NEW, Esq.,
Consulate-General of the United States of America, London, E. C.

A.

BOARD OF WORKS FOR THE GREENWICH DISTRICT.

Specification for forming and making up the roadway and paving, curbing, channeling, and making up the footpaths of the street called America, in the parish of ——, in the Greenwich district.

The contractor is to remove all slop, mud, clay, and soft material in proper slop carts when and as required by the road surveyor to the board of works for the Greenwich district for the time being, and to remove and cart away all superfluous earth and regulate the finished level of the roadway by the general level of the adjoining premises, as determined by the said surveyor.

The surface of the roadway to be properly formed by the contractor previously to the whole width of such roadway being covered by him with a good 9-inch dressing of hard pottery or brick waste, to be evenly spread and well rolled by him, after which he is to lay on such road a good 6-inch coating of Guernsey granite in two 3-inch dressings, and to well and evenly break, spread, water, and roll in the same with 10 tons.

The footpaths on both sides of the above road are to be paved with best 3-inch tooled York stone. (The width of footways can be stated.)

The contractor is to provide and fix on edge, on both sides of the above-mentioned road, a good 7 by 12 inch granite curb, squared at both ends, with close-butting joints, well jointed and parallel on the top, with circular and return curb for all the corners, gateways, and approaches, where required by the said surveyor, and to pave the channels with 5-inch by 6-inch and 6 inches deep approved granite cubes on both sides of the said street, to be set on best concrete 6 inches deep, three stones wide, and to pave the same to a proper gradient for the gulleys, to well grout the same with hot lime and sand, and well ram down the same.

The crossings, to be of best dressed granite, are to be paved by the contractor with 7-inch by 4-inch and 7 inches deep, to be laid on concrete 6 inches thick, to be well and properly rammed and grouted in with Shay sand and hot lime.

Any private gateways are to be paved by the contractor with 3-inch by 6-inch and 6 inches deep dressed granite cubes set on 4-inch concrete, to be well grouted in with hot lime and properly rammed.

The contractor is to shift and remove such of the present gullies as the said surveyor may direct, so as to range with the paved channels.

The contractor shall construct ——— gullies, in such places as may be pointed out by the road surveyor, with No. 1 best wire-cut Galt bricks, well bonded, 9 inches in thickness, in Portland cement, with invert bottom, the whole surrounded with Portland cement concrete 6 inches in thickness, the entire inner faces of the gullies to be rendered with Portland cement three-fourths of an inch in thickness, to connect the said gullies with the sewers, with best 6-inch (in the bore) glazed stoneware pipes jointed with clay; also to provide and fix a cast-iron grating and frame and cast-iron siphon trap (as per plan) to each gully, sample to be seen at the office of the board. The contractor must, previous to the commencement of the construction of any gully, give two days' notice to Mr. J. Nidd Smith, the district board's engineer, under whom and to whose entire satisfaction the work is to be performed.

All watching, lighting, fencing, and notices for gas and water companies and others which may be necessary shall be provided and given by the contractor, who will be held responsible for any accident or damage of whasoever description that may happen or occur during the progress or execution of or in completing the works referred to in this specification.

If, under the direction in writing of the said surveyor, the contractor omits to do any of the before-mentioned works, or to supply any of the before-mentioned materials, or does any additional work, or supplies any additional materials, then such omissions or additions shall be valued by the said surveyor, and the amount of said valuation deducted from or added to (as the case may be) the sum at which the contractor shall tender to execute the said works.

All the said works are to be executed and completed under the direction of the said surveyor, and to his entire satisfaction; and if any question should arise as to the labor or material, the levels, or the mode of executing the said works, or otherwise in reference to this specification, or with regard to any extras or omissions (if any), all such questions shall be finally determined by the said surveyor.

Advances of money at the rate of 75 per cent. on the value of the work executed, as certified by the said surveyor, will be made to the contractor as the works proceed until the whole of the works are completed, but such advances shall in no case be made at more frequent intervals than monthly, or until work of the value of £100, certified as aforesaid, shall have been completed, and such certificate shall be final and binding for the purpose of determining the amount of the advances to be from time to time made under this clause, but shall not affect the right of the board against the contractor, or be considered or be held at all conclusive as to the sufficiency of any work or materials; and such advances shall in no way affect any question in the ultimate settlement of the accounts, or be considered as proof or admission of any particular work, or amount of work, having been completed; and the balance shall be paid at the expiration of 3 months from the time when the work shall have been completed in accordance with the contract, and the said surveyor shall have certified in writing to the board that the works have been so completed to his satisfaction.

The commencement of the works referred to in this specification is to be postponed until the time for commencing the same shall be specified in a written notice, given to the contractor by the said surveyor, and the contractor shall commence the same at the time specified in such notice, and must execute and complete the whole of the said works within 3 calendar months after the time so specified for commencing them, and if the said works are not completed within the said period of 3 calendar months, the contractor shall pay to the said board the sum of 20*s*. for every day until the works are completed to the satisfaction of the said surveyor; and all such sums payable under this clause, and any expense which may be incurred by the board by reason of delay on the part of the contractor, shall be deducted from the amount payable to him under this contract, or paid by him to the board on demand.

The contractor must execute, when required, a written contract in due form, to perform, fulfill, and complete the works mentioned and referred to in the above specification, and in all respects according to the terms thereof.

J. R. H.,
Road Surveyor to the Greenwich District Board of Works.

B.

PARISH OF GREENWICH—NEW GRANITE AND WOOD PAVING WORKS.

BOARD OF WORKS FOR THE GREENWICH DISTRICT,
June 23, 1886.

Specification to pave the unpaved portions of the Greenwich road, from Wellington Grove to London street, of London street, from Greenwich road to Royal Hill, of Romney road, of Trafalgar road, and of the lower Woolwich road (except in front of Christ Church and the Wesleyan Chapel) from Trafalgar road to Marsh Lane, in the parish of Greenwich, with 7-inch by 3-inch, or 7-inch by 4-inch granite cubes, and to perform other works in connection therewith; and to pave the unpaved portions of London street from Royal Hill to Stockwell street; of Church street, from Stockwell street to Nelson street, and of Nelson street, and in front of Christ Church, and the Wesleyan Chapel in the lower Woolwich road, in the parish of Greenwich, with 6-inch by 3 inch wooden blocks, and to perform other works in connection therewith.

1. The contractor shall remove all the macadam or paving belonging to the board, forming the surface of the road between the curb and existing granite paving outside the tram rails to a formation level, and cart the macadam, paving, cubes, curb, or other stone to the board's wharf, or any other depot at a distance of not exceeding 2 miles from any part of the works.

2. The contractor shall dress the surface level at the foundation to the same profile as the paved surface will have when completed, and provide and lay thereupon and over the entire area thereof, a bed of concrete, 6 inches in depth.

3. The concrete for the granite paving is to be formed of the best fresh burnt ground blue Rugby, blue lias, or other approved hydraulic lime, clean sharp Thames or approved ballast, in the proportion, by measurement, of one part lime to four of ballast, to be laid in place and fretted to the required level at once, and, if required, to be well punned with iron rammers, and left undisturbed until the same is set and the granite sets are laid upon it.

4. The concrete for the wood paving is to be composed of best Portland cement, weighing not less than 116 pounds to the strike bushel, and is to bear a breaking weight of 410 pounds to the square inch, is to be mixed with clean sharp Thames or approved ballast, in the proportion, by measurement, of one part cement to four of ballast, to be laid in place, and fretted to the required level at once, and, if required, is to be floated to an even surface, and left undisturbed, until it is set and the wood blocks are laid upon it.

5. The contractor is to provide, deliver, and lay on a bed of clean sharp gravel mixed with blue Rugby, blue lias or other approved lime in the proportion of one of lime to four of gravel, on the concrete bed and parallel to the lines of curb, two courses of approved granite sets, 7 inches in depth and 4 inches in width, or 7 inches in depth and 3 inches in width, as may be directed, to form a channel where directed.

6. The contractor is to provide, deliver, and lay on a bed of clean, sharp gravel, mixed with blue Rugby, blue lias, dry, or other approved lime in the proportion of one of lime to four of gravel on the concrete bed, and between the existing paving outside the tram rails and the channel stones by the curb hereinafter described, approved granite sets 7 inches in depth and 4 inches in width, or 7 inches in depth and 3 inches in width, as may be directed, such sets to be properly bonded in with such existing paving.

7. The pitchings or sets are to be of the best and hardest description, each stone is to be 7 inches deep, and 3 or 4 inches in width, as may be directed, to be perfectly square on all sides, the bottom full and equal to the top, and before being used shall have the special approval of the surveyor. The top and bottom are to be roughed not hogbacked, and the stones are to be laid in regular courses, straight, parallel, and of an equal width and (except the channel courses specified above) at right angles with the curb, unless otherwise directed, and to be rammed and back rammed after the grouting as often as may be required by the said surveyor.

8. The wood paving to be of the best sound and approved pitch pine blocks, free from sap or knot, 6 inches deep, 3 inches in width by 9 inches, set as directed on a bed of clean sharp sand, mixed with Portland cement in proportion by measures of one of cement to four of sharp sand set at right angles with the curb, unless otherwise directed, and to be rammed and back rammed after the grouting as often as may be required by the said surveyor.

9. The grout to be formed of the best burnt ground blue Rugby, blue lias, or other approved hydraulic lime, and best clean sharp Thames or other approved sand of an equal quality in proportion by admeasurement of one of lime to three of sand; it is to be well worked up and amalgamated and spread upon the paved roadway and well worked into the joints and interstices with scrapers and brooms so as to run into and through and fill up all the joints and interstices, and afterwards is to be dressed over with washed and screened granite or gravel as often as may be considered necessary by the surveyor for 14 days after the road is open for traffic.

10. The contractor is to keep and maintain at his own cost and charges, in good and substantial repair, free from looseness, sinkings, holes, indents, wide joints, and all other imperfections, the whole of the works herein specified for one year after the date of the said surveyor's certificate that the whole of the works have been completed to his satisfaction.

11. In case any company or person shall at any time during the said twelve months open the roads or any part thereof, the work of relaying the granite and reinstating or repairing the road so broken up, shall be executed by the contractor, and the amount received by the board from such company or person for restoring the road shall be paid to the contractor.

12. From the date of the contract until the completion of the works, the board will water, scrape, sweep, and cart away the road scrapings and sweepings of such part of the roads as sh all be open for the public traffic, in such manner as the board may think fit.

13. The contractor shall commence the works within three weeks after he shall have received a written order to do so from the surveyor, and complete the works and deliver up the same to the said board, within 16 weeks after the receipt of the said order, under a penalty of £25 sterling per day, for each and every day that the same shall remain incomplete after the expiration of the said 16 weeks, and in case of such default, the amount of any penalty or penalties so incurred is to be deducted from any moneys due to the contractor, or recovered from him as liquidated damages.

14. The contractor shall not have or put forward any claim for any sum or balance of money whatsoever, as due to him from the board, except on the certificate of the surveyor.

15. That payment shall be made to the contrac tor for the works herein specified in manner following: 75 per cent. of the estimated value of the works executed on the certificates of the surveyor, such certificates to be granted at the expiration of every 4 weeks after the commencement of the works. Such further sum as shall make the total payments amount to 90 per cent. of the contract sum, with the amount of extra works (if any) added thereto, or if omissions, deducted therefrom, within 28 days after the date of the certificate of completion of the whole of the works to the satisfaction of the surveyor. A further payment of 5 per cent. thereon within 3 months after the said completion, and the balance within 12 months after the completion.

16. Should the works, in the opinion of the surveyor, not be carried on with sufficient despatch, or should the contractor neglect or refuse to amend any works or materials objected to by the surveyor, then it shall be competent for him, the said surveyor, after giving to the contractor 48 hours' notice of his intentions so to do, to employ other persons, or procure other materials, so as to perform and amend the said works, and all costs so incurred are to be deducted out of any moneys that may be due to the contractor in respect of the contract or extras thereon, or may be recovered as a debt, at the option of the board.

17. If any dispute shall arise between the contractor and the board, or between the contractor and the surveyor, as to meaning or intentions of this specification and tender, such matter shall be referred to and explained by the surveyor, whose explanation and award shall be final and binding upon the contractor and the board.

18. The contractor shall not be entitled to make any claim against the board for any works whatever, in addition to those herein tendered for, except such additional works shall have been performed, executed, and completed upon a written order, signed by the surveyor.

19. If the contractor should from bankruptcy, insolvency, or any other cause whatever be prevented or delayed in proceeding with the work, or be unable to proceed with the work, according to the contract, or shall not proceed therein to the entire satisfaction of the surveyor, it shall be lawful for the board, after seven days' previous notice to the contractor herein stated, of their intention so to do, to enter upon the works, and take possession of them, and of all materials and plant that may be on the works, and to employ other persons to complete the works, and at the option of the board the contract shall, at the expiration of the said notice, become void to the contractor, but without prejudice to any right of action the board may have. The contractor in such case shall have no further claim for such works, materials, or plant, but such payment as may have been previously made shall be considered and taken as payment in full for all such materials or plant, or work done.

20. In case of the death of the contractor before the works hereby undertaken by

him shall have been executed, performed, or completed, his executors or administrators shall execute, perform, and complete the same.

21. The contractor shall not underlet or make a subcontract for the execution of any portions of the works, nor assign or otherwise dispose of, or part with his interest in the contract, or any part thereof, without the previous consent in writing of the board.

22. The contractor or contractors shall securely and properly fence off and light the works during the progress thereof in such places and at such times as may be necessary for the safety of the public, or as the surveyor may direct, and whether the surveyor shall give directions or not the contractor is to be held responsible for any accident that may occur through noncompliance with or neglect of this clause. The contractor is to be held responsible for and to make good any damage to gas or water pipes, drains, fences, or other works or property damaged by him during the progress of the works, or which may occur in consequence of the works within 4 months after the completion, and in case of default on the part of the contractor the damage will be made good by the surveyor, and the amount thereof deducted from any money due, or which may become due to the contractor, or may be recovered from the contractor in an action.

23. The contractor shall include in his estimate the sum of 2 pounds 10 shillings per week to be paid by the board to their clerk of the works for superintending the works herein specified during the period of their execution, and the sum so paid to such clerk of the works shall be deducted from the amount of the contract after its final completion.

24. All the materials and workmanship of their several kinds are to be of the best description, and are to be approved by the surveyor.

25. In this tender and contract the word "contractor" shall include his heirs, executors, or administrators." "The board" shall mean the board of works for the Greenwich district. The "surveyor" shall mean the road surveyor of the board for the time being, or any other surveyor from time to time appointed by the board in respect of this contract.

26. Every notice shall be deemed to be served upon the contractor which shall have been put into the post addressed to the contractor at his address hereunder stated, or to any other address which he may furnish in writing to the clerk of the board.

BOARD OF WORKS FOR THE GREENWICH DISTRICT,

Parish of Greenwich:

—— hereby tender to and agree to perform and keep in repair for 12 calendar months, all the works in the foregoing specification, and to perform all the conditions thereof at the price hereunder stated per superficial yard of road surface, broken up and paved with new granite or wood cubes in manner hereinbefore mentioned.

Price per yard superficial if the paving is executed in—	*s.*	*d.*
7 × 3 Mount Sorrel granite	15	0
7 × 4 Mount Sorrel granite	13	0
7 × 3 Guernsey granite	15	0
7 × 4 Guernsey granite	14	0
7 × 3 Aberdeen granite	14	0
7 × 4 Aberdeen granite	13	0
Price per yard superficial for wood paving 6 × 3 × 9 pitch pine	10	6

And —— further agree to relay the existing paving outside the tram lines where required by the surveyor to do so, at the price of —— per superficial yard.

And —— agree to execute a contract for the performance of the works, as aforesaid, upon being requested to do so.

(*Name of person tendering:*) ——— ———,

(*Address:*) ——— ———.

Tenders must be delivered at the board's office, 141, Greenwich road, not later than 4 o'clock on Wednesday, 23d June, 1886.

Schedule of Prices.

Parties tendering are required also to fill in prices for additional works as per following schedule:

	s.	d.
To supply and fix new 12 × 7 Aberdeen edge curbs, at per foot run extra....	1	10
To supply and fix new 12 × 6 Aberdeen edge curbs, at per foot run extra....	1	8
To supply and fix new 12 × 8 Guernsey channel curbs, at per foot run extra.	2	2
To take up existing curbs and reset same, at per yard run.....		2
To take up, redressing, and resetting curbs, at per yard run		6
To supply and lay complete best 3-inch Yorkshire flaggings, at per foot superficial		10½
To supply and lay complete best 2½-inch Yorkshire flaggings, at per foot superficial		9½
To remove and relay old York, to square and relay same at per 100 feet.....	10	6
To relay old channel, carriageway cubes and grout same complete, at per yard superficial.....	1	2
To supply and lay down on a bed of Portland cement concrete, 6 inches in thickness, the concrete to be composed of one part Portland cement to four of clean Thames ballast, approved pitch pine blocks, 6 by 3 by 9 inch, of the best quality, free from sap or knots, at per yard superficial.....		
To supply and lay down on a bed of Portland cement concrete, 7 inches deep and 3 inches in width, at per yard superficial.....		
To take up, redress if necessary, and relay on any portion of the works, any old cubing as directed, at per yard superficial.....		
To supply and lay concrete as described in clause 3 of specification at per yard cube		

All digging and carting in any way connected with, preparing for, or in the execution of the works herein referred to, shall be included in the above prices.

REPORTS OF MR. HAYWOOD.

The following four inclosures in Consul-General New's report are reports of Mr. Haywood, engineer and surveyor to the commissioners of sewers of the city of London.

ACCIDENTS TO HORSES ON CARRIAGEWAY PAVEMENTS.

SEWERS OFFICE,
GUILDHALL, *December* 16, 1873.

To the HONORABLE THE COMMISSIONERS OF SEWERS OF THE CITY OF LONDON:

GENTLEMEN: The following is the reference made to me:

"That the engineer cause observations to be made and particulars taken as to the number of accidents befalling horses on the asphalt, wood, and granite pavings, under as nearly as possible similar circumstances, distinguishing the different results under various conditions of weather, and showing the percentage of accidents under each circumstance and condition; also taking note of any other particular he may think desirable, with a view to elicit the greatest possible amount of information respecting the various pavements."

After considering the means to be taken for obtaining the desired information with the least delay and expense, I came to the conclusion that the police could be usefully employed for the purpose; accordingly I applied to Colonel Fraser, who expressed his

willingness to assist the commission by allowing a certain portion of the police force to take the daily observations, and arrangements were ultimately made with him to this end.

Books were then prepared by me in such manner as appeared best suited to insure accuracy in recording the traffic and accidents, as well as to reduce the labor of the work. These books when filled up by the police, were placed in the hands of my assistants, who checked the casts, and arranged the figures so as to enable me to prepare the summaries and tables which are herewith submitted.

Forty-three men were employed altogether in taking the observations of traffic and accidents, 38 of whom were constables. The constables acted under the inspection of 4 sergeants, and their duty was so arranged that inspection was never taken off them. The whole service was directed and superintended by the chief inspector of police.

The observations taken were:

Firstly, of the traffic: The number of horses and vehicles which passed through the selected streets.

Secondly, of the accidents which occurred to the horses.

I. *Traffic.*—For ascertaining the traffic 2 men were stationed at each point of observation, and on opposite sides of the way, each man taking the traffic on the side of the road which was nearer to him, and passing in one direction only. The men were employed for 3 hours at a time, and were then relieved by others for 3 hours; and there were, therefore, altogether 4 men employed during the day at each point of observation. Each man was on duty for 6 hours daily. The observations were taken from 8 a. m. to 8 p. m., a period of 12 consecutive hours.

Observations of the main streams of traffic were taken at each selected spot for 2 consecutive days in a week; and were followed by 2 other days' observations in the week after, but on different days to those of the preceding week. They were carried on in such order until 6 days' observations, including every day in the week (Sundays excepted) had been taken at each point. Observations of cross or collateral traffic were also taken sufficiently to enable the effect on the general stream of traffic to be ascertained.

Whilst the traffic was being taken none of the streets in the vicinity of the main thoroughfares under observation were materia lly obstructed for paving or other works and the traffic was therefore in its normal state.

II. *Accidents.*—The number of men employed in taking account of the accidents was 30, 15 being on at a time. The relief took place every 3 hours, and the men were subject to the same supervision by the inspectors and chief superintendent as those taking the traffic.

The observers were stationed at such points as enabled each man to see easily the area assigned to him without moving far from a central position. These points had been fixed after careful observation by myself, so as to ascertain the area which could be properly watched. Each man recorded all the accidents which occurred on his assigned area.

Owing to differences in the extent and nature of the traffic, the width of streets, and other conditions, the length of thoroughfare assigned to the men varied from 239 feet to 636 feet, and the areas from 640 to 2,071 yards superficial; the mean of the whole being one man to every 333 feet lineal and 1,226 yards superficial of carriageway pavement. These lengths and areas are shown on the plan accompanying this report, and also in Table A in the appendix.

The observations of accidents were commenced on the 10th March last, and continued until the 5th April, during which time the weather was generally fine. As there was no appearance of change in the weather, and it being in the highest degree desirable to have observations during all kinds of weather, they were then discontinued. On the 9th May, as rainy weather appeared likely to ensue, they were resumed, and continued until the 7th June. The weather, however, became again fine, and continued for the most part so until the observations were completed. They were discontinued because police arrangements did not admit of their being prolonged.

As the horse traffic in the city is much less on Sundays, being in fact in the main streets only from 20 to 30 per cent. of that which passes on other days in the week, the observations were confined to working days alone.

By omitting Sundays there were 50 working days on which observations of the accidents were made.

As the expense would have been largely increased by taking observations during the night; as owing to the darkness they would have been less reliable; and as the great bulk of the traffic passes through the city thoroughfares between 8 a. m. and 8 p. m., observations of accidents were made only during those 12 hours of day.

During the first three weeks the accidents were recorded without explanation of their nature; but as a large proportion of the horses were observed to fall only on their knees, the accidents on the remaining 32 days were classified under the heads of "falls on knees," "falls on haunches," and "complete falls." No notice was taken of the mere slipping of a horse.

The weather during the observations will now be generally described, for, whatever be its character, weather affects the surface of all pavements and largely influences the conditions under which slipperiness varies.

The direction of the wind varied during the 50 days, but was principally either from the north, east, or northeast. The prevailing direction was northeast.

The mean temperature of the 24 hours, as taken from the registrar-general's returns during the period, varied from 34.5° to 60.9°. The observations of temperature taken in Guildhall yard by me daily, at 9 a. m. and 3 p. m., show a variation of from 35.7° to 64.8°. The mean daily temperature was for the most part somewhat below the average.

Out of the 50 days there were but 17 days on which rain fell. On the average there are 150 days annually in London in which rain falls at some period during the 24 hours; therefore, during the 50 days' observations there was proportionately less than the usual number. I find also there was a less number of rainy days than the average during those particular months, and that the quantity of rain was far less than usual. This is a fact much to be regretted, inasmuch as the slipperiness of all pavements is very much affected by moisture, although in different manners and in different degrees. The character of the weather will be further dealt with in another portion of the report.

The reference to me being to take observations of the accidents befalling horses on asphalt, granite, and wood, and there being a variety of each of these classes of pavement on each of which the slipperiness varies, it became necessary in the first place to determine which to select, and I ultimately chose one of the compressed asphalt of the Val de Travers Company, and one formed of 3-inch Aberdeen granite cubes, these two kinds being the best known and the most extensively used in London of their several classes. I also selected the improved wood pavement, this being the only one of which there was any large quantity laid down in the city, and a specimen of the ligno-mineral pavement which lay adjacent to it.

It would have been desirable to have had observations taken in streets of similar width and gradient, of which the pavements were in equally good condition of repair, and the traffic passing over them as nearly as possible the same in character and extent, as comparisons would then have been more easily made, and discrepancies more readily accounted for. This similarity in conditions was unattainable; and after giving the subject much consideration, I selected Cheapside and the Poultry, King William street, part of Gracechurch street, and the eastern portion of Cannon street, of which the surface conditions generally were:

Asphalt.—Cheapside and the Poultry were paved with the compressed asphalt of the Val de Travers Company, laid 2¼ inches thick, on a bed of concrete 9 inches thick. The surface of this pavement was in good condition.

The total length of these two thoroughfares was 2,033 feet, and the area of the carriageway 6,914 yards superficial. The worst gradient was on a length of 48 feet

next to St. Paul's churchyard, which was 1 in 58. The other gradients varied from 1 in 66 to 1 in 550, nearly the whole length of the two thoroughfares being less steep than 1 in 70.

The traffic in Cheapside and the Poultry was of a mixed character, including a considerable number of omnibuses. It was for the most part slow, especially in the Poultry.

Granite.—King William street from Cannon street to Lombard street, and Cannon street from King William street to Walbrook, were paved with Aberdeen granite. The stones were 3 inches wide, 9 inches deep, and from 9 to 15 inches long, laid so as to touch each other, the joints being filled in with stone lime grout. The pavement of Cannon street was a little out of repair; that of King William street in a bad state of repair. The latter was under order to be replaced by a new pavement, which has since been laid.

The pavement in King William street was 675 feet long, and had an area of 2,379 yards. A length of 138 feet at its northern end had a gradient of 1 in 54; the remainder was from 1 in 68 to 1 in 1,000.

The traffic in this part of King William street was much the same in character as that in Cheapside and the Poultry, but on the average it passed through it at a greater speed than in the other thoroughfares under observation.

The portion of Cannon street under observation was 807 feet long, and its carriageway had an area of 2,752 yards. A length of 326 feet at the western end had gradients of 1 in 30 and 1 in 31. The remainder varied from 1 in 61 to 1 in 841.

The traffic in Cannon street was generally slow, a large number of one-horse vehicles passing through it, and only a few omnibuses. Carts stopped for loading and unloading in front of the premises on the southern side of the street during the largest portion of the day.

Wood.—The wood pavements under observation were two in number; that of the Improved Wood Paving Company, and that of the Ligno-Mineral Paving Company (Trenaunay's patent).

King William street from London Bridge to the Statue, and a small portion of Gracechurch street, were paved with the improved wood pavement, which is formed of fir blocks 3 inches wide, 5 inches deep, and 9 inches long. The blocks are laid touching each other at their ends, but crosswise of the street, the joints are three-quarters inch wide, filled in with fine clean gravel, and then grouted with a bituminous composition. The total length of this pavement was 1,394 feet, its area 5,937 yards. Its surface was in excellent condition.

A length of 130 feet of this pavement near to Crooked Lane had a gradient of 1 in 30. Near to Eastcheap was a length of 83 feet with a gradient of 1 in 34. The remainder varied from 1 in 37 to 1 in 260. Near to the statue of King William IV the pavement had also in several places a steep transverse slope.

The pavement in Gracechurch street of the Ligno-Mineral Paving Company consisted of beech blocks, 3½ inches wide, 6 inches long, and 4½ inches deep, laid with longitudinal and transverse joints one-quarter inch wide. The wood was mineralized, and the joints were filled in with cement or lime grout. It was laid on a bed of concrete 5 inches thick. The surface was in good condition.

The length of the ligno-mineral pavement was 87 feet, the area 410 yards, and the gradient 1 in 49.

The traffic over the wood pavements in King William street and Gracechurch street comprised vehicles of all descriptions, and in King William street included very much of that which passed through the other thoroughfares under observation. The traffic passed generally at a slow rate, but from Arthur street to London Bridge during two or three hours of the day it was less slow in the center of the street.

It is necessary to make some further remarks in reference to these wood pavements.

When I included for observation the two kinds described, I did so because it was desirable to observe considerable lengths of street. The pavements were adjacent to

each other, and could be conveniently watched from one station. It did not then occur to me that there was any material difference between the two in respect of safety; but as investigation into the causes of the accidents advanced and the various abstracts and tables were made up a very remarkable difference became apparent. I do not feel justified in leaving out the observations taken on the ligno-mineral pavement, and the accidents which occurred on it are accordingly included with those which occurred on the improved wood pavement, and they are given together in the totals and general results. If there had been no more than a trifling difference between them in the proportion of accidents I should take no notice of this difference, for looking at the mixed causes which lead to accidents it might not have been practicable to do so usefully; but the excess of falls on the ligno-mineral is so great as materially to alter the relative position of the wood to the other pavements as regards safety. Although, therefore, as before said, the general tables include the accidents on both, it has been necessary to separate them in various parts of the report to prevent erroneous conclusions being drawn.

The lengths and areas of the thoroughfares under observation will be found in Table B in the appendix.

All the pavements during the period of observation were cleansed every morning and were also cleansed constantly during the busiest hours of the day by street orderlies. The asphalt was occasionally, but not frequently, washed in the morning; and all the pavements were, therefore, as clean as the nature of their respective surfaces admitted with the amount of labor and expense which was ordinarily bestowed on them. No measures were taken to keep them cleaner than the other main thoroughfares in the city.

It was frequently noticed that accidents occurred on the asphalt when it was dry, owing to the horses putting their feet on fresh droppings; but scarcely any appear to have taken place from this cause either on the granite or the wood.

During the period of observation the asphalt was not watered to lay the dust, it not being customary to water that material, but the granite and wood were watered the same as other thoroughfares of the city.

Some of the accidents on the wood were undoubtedly attributable to the moisture caused by this surface watering, but accidents attributable to a similar cause do not appear to have taken place on the granite pavement.

The asphalt, when the surface was damp or slippery, was occasionally strewn with fine sand by the street orderlies, but this sand was used sparingly, and owing to the state of the weather the necessity for using it was small.

The improved wood pavement was on four occasions during the observations slightly strewn with fine gravel. This was done by the contractors to indurate the surface in the way customary with wood pavements. On only one of the four occasions was the pavement in such a state that strewing gravel was likely to be useful to prevent accidents.

Nothing was strewn either by the contractors or by the commission on the ligno-mineral pavement during the time it was under observation.

In the calculations, which are based on the extent of traffic, the mean traffic arrived at by observation has been taken to apply to the whole time during which the observations of accidents were made. It would, of course, have been more strictly correct to have made daily observations of the traffic throughout the whole period simultaneously with those made of the accidents; but to have made them would have largely increased the expense, and experience has shown that it is unnecessary to prolong such observations for the purpose of obtaining averages.

It is assumed in this report that each horse traversed the entire line under observation. Each line was carefully defined, measured, and separately calculated. For example, at the western end of Cheapside there were three streams of traffic, each stream having a different length of journey. On each of these the number of horses and the accidents occurring to them were separately recorded and the mileage trav-

eled by the horses ascertained. The same was the case near the statue in King William street, where there were various lines of traffic, all of which were dealt with in a similar manner. The collateral traffic was not taken for any length of time—to have done so would have much increased the expense—but it was taken at every cross street, so as to learn how the average number of horses passing through the main line was affected by it, and the variation in numbers was found to be, generally speaking, as much on the one side as on the other. As the observations on the main lines were all taken from points selected, so as to include the collateral traffic as far as practicable, it is believed that a very correct average of the whole has been obtained.

It has now to be stated that although the scope of the reference is wide, yet in writing this report I have thought it desirable to keep closely to the manifest object of the reference, which is, as I understand it, *to ascertain by direct observation the relative safety of the three classes of pavement.* I have therefore not referred to statements made from time to time to the commission, either by the owners or drivers of horses, the proprietors of pavements, the police, or the public as to the safety of particular pavements. Nor have I referred to previous observations or to other information already before the commission on the subject, but have dealt simply with the results of the observations specially made for this report.

I have also avoided entering on the advantages and disadvantages generally of the different kinds of pavements.* To have done so would have made this report an essay on pavements rather than a report on the accidents occurring on them. I have avoided as far as possible giving opinions of my own on the matter, though it has been essential to draw attention to those conditions under which the pavements differ from each other, and for which difference due allowance will have to be made in judging the results. Had I not done so the general results given in some of the tables might have been taken as applicable to similar pavements under all conditions and seasons, which would have been erroneous.

A plan is appended showing the pavements which were under observation, their nature and gradients, with the horse traffic which passed at certain places, and it contains other information explanatory of the report.

The most important of the abstracts by which the tables and summaries are arrived at, and from which the conclusions set forth in the report are drawn, are also appended. By reference to these abstracts the details of the observations will be seen. These abstracts are:

(A) Table showing length and superficial area of carriageway pavement observed from each station.

(B) Table showing the length and superficial areas of the thoroughfares in which the observations of traffic and accidents were taken.

(C) Table showing the number of horses and vehicles passing through various thoroughfares during 12 hours, from 8 a. m. to 8 p. m.

(D) Table showing the mean numbers of vehicles drawn by 1 horse, 2, and 3 or more horses that passed over the various pavements in 12 hours, from 8 a. m. to 8 p. m.

(E) Table showing the number of horses that fell on the various pavements between 8 a. m. and 8 p. m., the state of the weather, the direction of the wind, and other information during certain days in March, April, May, and June, 1873.

(F) Table showing the traffic, number of horses that fell, and the distance traveled before a horse fell on each of the various pavements.

(G) Table showing the proportions of horses that fell on knees, on haunches, and completely on the various pavements during 32 days' observations.

(H) Table showing the number of horses that fell in vehicles drawn by 1 horse, 2, and 3 or more horses.

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*These will be dealt with in a report upon the relative advantages of wood and asphalt, which I shall shortly commence.—W. H.

(I) Table showing the total number of horses that fell in vehicles drawn by 1 horse, 2, and 3 or more horses over the three descriptions of pavement.

(K) Table showing the distance traveled by horses in vehicles drawn by 1 horse, 2, and 3 or more horses, respectively, before a horse fell.

(L) Table showing the order of slipperiness as compared with the gradients upon each class of pavement.

Throughout the report the pavements are referred to in alphabetical order: Asphalt, granite, wood; this being a convenient mode to adopt for general reference, as well as for other reasons. They are transposed in some of the tables incorporated in the body of the report, where they have been arranged so as to show more clearly their relative safety.

Having now laid before the commission a general account of the nature of the observations taken and the manner in which they have been used, I proceed to state the general results.

TRAFFIC.

The horse traffic daily between 8 a. m. and 8 p. m. on the working days in the months of March and April, 1873, during which the observations were taken, are given in table C in the appendix; the mean traffic at the most important points on the lines was:

	Number of horses passing from 8 a. m. to 8 p. m.
Asphalt:	
Cheapside, east of Milk street	12,366
Poultry, by Grocers' Hall court	10,920
Granite:	
King William street, by Abchurch lane	8,555
Cannon street, by Bush lane	5,350
Wood:	
King William street, north of Arthur street	21,162
Gracechurch street, by Talbot court	11,484

The vehicular traffic was separated in the observations under the heads of one, two and three or more horse vehicles. The details of these observations are given in Table D in the appendix, but the mean number which passed at the most important points on the line is given in the following table:

Table showing the mean number of one, two, and three or more horse vehicles, respectively, passing through the streets under observation in March and April, 1873.

	Mean number of vehicles passing from 8 a. m. to 8 p. m.			Total.
	One horse.	Two horses.	Three or more horses.	
Asphalt:				
Cheapside, east of Milk street	6,533	2,825	61	9,419
Poultry, by Grocers' Hall court	5,472	2,637	58	8,167
Granite:				
King William Street, by Abchurch lane	4,276	2,006	89	6,371
Cannon street, by Bush lane	4,090	585	30	4,705
Wood:				
King William street, north of Arthur street	10,273	4,831	409	15,513
Gracechurch street, by Talbot court	5,817	2,469	243	8,529

The proportions of the whole are as follows:

	Per cent.
Vehicles drawn by one horse	71.42
Vehicles drawn by two horses	26.95
Vehicles drawn by three horses	1.63

Some general idea of the character of the vehicles which passed along these thoroughfares, together with the proportion which the several classes bear to each other, are now given. The observations were not taken on the same day as those on which the observations of traffic and accidents were recorded. Nevertheless they fairly represent the proportion of the several classes of vehicles.

Table showing the proportions of the different classes of vehicles passing through the various thoroughfares during 12 *hours, from* 8 *a. m. to* 8 *p. m., on certain days in November,* 1873.

Street.	Percentage to total traffic.					
	Cabs.	Omnibuses.	Railway vans.	Tradesmen's carts.	All other vehicles.	All vehicles.
Cheapside	38	22	17	8	15	100
Poultry	38	28	13	7	14	100
King William street, by Abchurch Lane	29	22	19	8	22	100
Cannon street, by Bush Lane	40	2	28	10	20	100
King William street, north of Arthur street	19	20	25	10	26	100
Gracechurch street, by Talbot court	23	9	31	12	25	100

ACCIDENTS TO HORSES.*

The number of accidents and the average distance traveled before an accident occurred.

The number of horses that fell during the whole period of 50 days, together with the places at which the accidents occurred, and other particulars relating thereto, are given in Table E in the appendix, and may be identified on the plan attached. The general results are:

Asphalt:	
Cheapside	932
Poultry	134
Total on asphalt	1,066
Granite:	
King William street	429
Cannon street	290
Total on granite	719
Wood:	
King William street and Gracechurch street, improved wood pavement	380
Gracechurch street, ligno-mineral pavement	162
Total on wood	542
Total on all pavements	2,327

which gives a daily mean over the various pavements during the 50 days of—

Asphalt:	
Cheapside	18.64
Poultry	2.86
Total on asphalt	21.32

*See Note by Department on page 297.

Granite:	
King William street	8.58
Cannon street	5.80
Total on granite	14.38
Wood:	
King William street and Gracechurch street—improved wood pavement	7.60
Gracechurch street—ligno-mineral pavement	3.24
Total on wood	10.84

No opinion of value as to the relative safety of the different classes of pavement can, however, he formed by simply comparing the number of horses which fell in any one thoroughfare with the number which passed through it—or by comparing the falls with those which took place in another thoroughfare, inasmuch as the risk of falling which a horse incurs on a pavement necessarily depends on the length of the pavement traversed. With the view, therefore, of arriving at a correct conclusion, the various streams of traffic, as well as the distances traveled, were taken separately, and thus the exact distance which was passed over before an accident occurred was ascertained. These lengths are given with much other detail in Table F in the appendix, but the totals in each street are given the following table:

Table showing the total distance traveled by horses over the different pavements, and the total number of accidents during the 50 *days' observations.*

Description and situation of pavement.	No. of accidents.	Distance traveled.
		Miles.
Asphalt:		
Cheapside	932	172,783
Poultry	134	31,022
Granite:		
King William street	429	54,683
Cannon street	290	40,884
Wood:		
King William street and Gracechurch street, improved wood pavement	380	169,690
Gracechurch street, ligno-mineral pavement	162	9,461
	2,327	478,523

The aggregate distance traveled by the horses included in the 50 days' observation was, therefore, 478,523 miles. The general result was that a horse might during that time have been expected to travel along the three pavements—in the proportions due to their lengths—a distance of 205 miles before an accident occurred. The distances, however, differed materially on the various pavements, examination showing that a horse might have been expected to travel on the—

	Miles.
Asphalt:	
In Cheapside	185
In Poultry	231
Mean of the asphalt	191
Granite:	
In King William street	127
In Cannon street	140
Mean of the granite	132
Wood	
In King William street and Gracechurch street, improved wood pavement.	446
In Gracechurch street, ligno-mineral pavement	58
Mean of the wood	330

The order of slipperiness during the 50 days was, therefore, ascertained to be:

	Miles.
1. Granite	132
2. Asphalt	191
3. Wood	330

The observations therefore show that a horse might have been expected to travel before it met with an accident the least distance on the granite, a greater distance on the asphalt, and the greatest distance on the wood.

These figures are correct as far as they go; but to adopt them as determining the relative slipperiness of the various pavements, without considerable limitation and correction, would be unsafe. To arrive at a correct opinion it is necessary to make further investigation, in order to see whether any portion of the accidents was due to conditions in which one pavement was more favorably circumstanced than others, apart from the difference resulting from the material of which the pavement was composed. Above all it is necessary to ascertain whether the general results would have been changed if the observations had been extended over a much longer period of time, including other seasons of the year, and every description of weather. With that object the accidents are now investigated and considered under the following sections:

(1) Nature of the accidents to horses.
(2) Effect of harnessing.
(3) Effect of rate of travel.
(4) Effect of gradient.
(5) Effect of condition of surface repair.
(6) Effect of surface cleanliness.
(7) Effect of weather on toe surface.

Before proceeding, however, to these separate considerations, some further information derived from the observations may be usefully given.

It might have been expected that a large proportion of accidents would have occurred at or near to the point of junction of one pavement with another of different character. The observations show that such was not the case to any material extent, excepting in King William street, at the junction of the asphalt with the granite. Even in this case investigation assigns other conditions as in some degree accounting for the large proportion of falls which occurred at that spot.

It might also have been anticipated that many accidents would have occurred at points where the collateral traffic either joins or leaves the main stream; for at those points a horse has not only a direct draft, but has to exert force laterally, and withstand the drag of the vehicle in turning, which in the city streets usually causes the wheels to grind against the curbstones. The returns show that although near to the junction of Bow lane, Bread street, and Gutter lane a somewhat large number of accidents took place, yet at Wood street, Foster lane, and Friday street, where there was a larger collateral traffic, no such excess occurred. Indeed, looking at the returns it would seem that the collateral traffic led to accidents to the horses moving on the main line, by causing them to be pulled up suddenly, rather than itself suffering accidents from turning into or out of the main line. It is probable that the superior safety on the asphalt in the Poultry, to that in Cheapside, is attributable in some degree to the absence of much collateral traffic, although the slower rate of travel in the Poultry was the most important element in causing that result.

NATURE OF THE ACCIDENTS TO HORSES.

It has already been stated that the accidents were at first recorded without explanation of their character, but that for 32 days they were taken under the respective heads of "falls on knees," falls on "haunches," and "complete falls."

The inconvenience caused to the general traffic of a street by an accident to a horse

differs materially. A horse which falls on the knees generally recovers itself speedily, and creates but little obstruction. One which falls on the haunches, and especially on a pavement with little joint or foothold, recovers itself with more difficulty, and is longer in doing so than if it falls on the knees; whilst if it falls on the side it has more frequently than otherwise to be unharnessed before it can regain a standing position, and, therefore, causes more obstruction than either of the other classes of accident.

It is probable that the injury to horses is greater when they fall on the haunches than when they fall on the knees, owing to the strain to which they subject themselves when attempting to rise. This is especially the case when they are in single harness drawing heavily-laden two-wheeled vehicles and fall on a pavement without joints. Complete falls, if sudden and sharp, are probably still more injurious when the pavement on which the accident takes place is a very hard one. Facts on these points are difficult to obtain, but the matter is worthy of serious consideration.

Details of the accidents are given in Table G in the appendix, but the following table gives the general results:

Table showing the numbers of falls on knees, on haunches, and complete falls on the three pavements during 32 days' observation.

Description of pavement.	On knees.	On haunches.	Complete.	Total.
Asphalt	140	107	190	437
Granite	135	22	134	291
Wood	277	10	39	326
Total	552	139	363	1,054

Which gives the following general proportions, viz:

	Per cent.
Falls on knees	52.37
Falls on haunches	13.19
Complete falls	34.44

And separating the accidents as they occurred on the different pavements, the proportions are:

Description and locality of pavement.	Accidents during 32 days' observations.		
	On knees.	On Haunches.	Complete.
	Per cent.	*Per cent.*	*Per cent.*
Asphalt: Cheapside, Poultry	32.04	24.48	43.48
Granite: King William street and Cannon street	46.39	7.56	46.05
Wood: King William street and Gracechurch street	84.97	3.07	11.96

This table shows that of falls on knees, the wood had by far the greatest proportion, more than five-sixths of the accidents being of this class, and that asphalt had the fewest falls on knees.

Of falls on haunches, the asphalt had the largest proportion, and was very largely in excess of those on either of the other pavements, and that the wood had the smallest proportion of this class of accidents.

Of complete falls, there were fewest on the wood and most on the granite, but the difference between the asphalt and granite was in this respect small, and on both

asphalt and granite there was something like four times the porportion of complete falls that there were on the wood.

Separating the accidents which occurred respectively on the two wood pavements which were under observation, the following are the results:

	Accidents occuring during 32 days' observations.		
	On knees.	On haunches.	Complete.
	Per cent.	*Per cent.*	*Per cent.*
Improved wood pavement	84.00	3.60	12.40
Ligno-mineral pavement	88.16	1.31	10.53

Thus it appears, generally, that horses traveling on the wood pavement were on the whole subjected to falls of a character less inconvenient to the general traffic of the street, and also less likely to be injurious to the horses, than those traveling on the other two pavements, and that in this respect the ligno-mineral was superior to the improved wood pavement.

It was noticed also, that whatever was the nature of the accident, the horses recovered their feet more easily on wood than they did either on asphalt or granite.

EFFECT OF HARNESSING.

Although it but little affects the end for which this report was prepared, it may be interesting to show how the horses to which the accidents occurred were harnessed.

The observations were taken under the heads of one horse, two, and three or more horse vehicles, and are shown by Tables H and I in the appendix. The general result on all the pavements during the 50 days' observation gives:

	No. of falls.	Percentage of whole.
Falls to horses in one-horse vehicles	1,279	54.96
Falls to horses in two-horse vehicles	927	39.84
Falls to horses in three or more horse vehicles	121	5.20
	2,327	100.00

Assigning these to the various pavements on which the falls took place, the results were:

Asphalt:

Cheapsie and Poulry: Per cent.

Falls in one-horse vehicles	55.81
Falls in two-horse vehicles	41.56
Falls in three or more horse vehicels	2.63

Granite:

King William street and Cannon street:

Falls in one-horse vehicles	58.83
Falls in two-horse vehicles	36.58
Falls in three or more horse vehicles	4.59

Wood:

King William street and Gracechurch street:

Falls in one-horse vehicles	48.16
Falls in two-horse vehicles	40.77
Falls in three or more horse vehicles	11.07

Thus, on all classes of pavement the largest percentage of accidents occurred to horses drawing one-horse vehicles. It has already been shown that vehicles drawn by one horse form the largest proportion of the traffic, being, in fact, 71.42 per cent. of the whole, whereas those drawn by three horses or more are but 1.63 per cent. of the whole; and, therefore, as in previous calculations, it is necessary to ascertain the distance traveled by the various classes of vehicles in order to see what was the actual risk incurred under the different modes of harnessing. These distances are shown in detail in Table K, but the general results are that, during the 50 days' observations, a horse might be expected to travel the following distances before it met with an accident:

Table showing the average distance traveled before a horse fell, in vehicles drawn by one horse, two, three, or more horses respectively.

Asphalt:
Cheapside and Poultry.

	Miles.
A horse in a one-horse vehicle	179
A horse in a two-horse vehicle	211
A horse in a three or more horse vehicle	116

Granite:
King William Street and Cannon Street.

A horse in a one-horse vehicle	138
A horse in a two-horse vehicle	131
A horse in a three or more horse vehicle	72

Wood:
King William Street and Gracechurch street.

A horse in a one-horse vehicle	352
A horse in a two-horse vehicle	349
A horse in a three or more horse vehicle	165

The result of the 50 days' observations therefore was:

That on all three classes of pavement the greatest risk of accident was to horses in vehicles drawn by three or more horses.

That on asphalt there was more risk of a horse falling in a one-horse than in a two-horse vehicle, but that on granite and wood the risk was very nearly the same, whether the vehicle was drawn by one or two horses.

It may be observed that in the three-horse vehicles the horses were nearly always in single file, and that in the two-horse vehicles the animals were almost invariably abreast, the exception being principally brewers' drays and market gardeners' carts and wagons.

EFFECT OF RATE OF TRAVEL.

Fast traveling is the cause of accidents in thoroughfares of much traffic, such as those of the city of London, inasmuch as it frequently involves either sudden reduction of speed or actual stoppage of the horse, which is more or less difficult according to the degree of foothold that the pavement affords. It is more difficult to stop a horse on asphalt than on granite or on wood.

Of the streets under observation, that in which the traffic usually moved with the greatest speed was King William street from Common street to Lombard street. The carts which loaded and unloaded there were few.

Cheapside at certain hours of the day and on a portion of its length only had a somewhat quick traffic along its center, but not so quick as the traffic over the narrow part of King William street. In the Poultry the traffic was uniformly slow; which fact in some degree may explain the other fact observed—that a horse saw

shown to travel there before an accident occurred a greater distance than in Cheapside. Both pavements were of the same material and in the same condition of repair.

In King William street and Gracechurch street, where they were paved with wood, the traffic during the twelve hours in which observations were taken was, northwards of Arthur street, for the most part slow, and southwards of that street perhaps a little quicker in the center during some hours of the day, but not materially so.

The granite was, therefore, on the whole, more disadvantageously placed in respect of speed of travel than either the asphalt or the wood; but a careful examination of the accidents does not enable me to state what proportion of these was attributable to this cause, although there is little doubt that in King William street (granite) some accidents were due to speed, especially as the surface of that pavement was in bad condition.

EFFECT OF GRADIENT.

The power required to draw a load increases directly a level surface is departed from, but the difference is not appreciable when the gradient is slight. The power varies according to the nature of the road surface, the state of repair, the way horses are laden and harnessed, and other conditions. Speaking generally and in round numbers, it has been demonstrated that a horse can, with the exertion of the same force, draw up a gradient of 1 in 100 about nine-tenths of the load which it can draw on a level surface, and about eight-tenths of the same load if the gradient be 1 in 50. After that the tractive power needed increases more rapidly, for on a gradient of 1 in 30 a horse can draw little more than six-tenths of the same load that it can on a level surface. For practical purposes a rod, ever if it be paved with asphalt, may be considered to have a safe and convenient inclination at 1 in 60; but under all conditions of surface and gradient the extent to which a horse is laden is a material consideration. The chance of an accident to a horse is greater when it is heavily laden than when lightly laden. It its necessary therefore to inquire further into the nature of the gradients of the various thoroughfares under observation in order to see if one street was more favorable than another.

Asphalt.—The gradients of the asphalt in Cheapside and the Poultry were excellent; there being but a very short length at the western end of Cheapside which was as steep as 1 in 58.

Granite.—The gradients in King William street were for the most part excellent. In Cannon street there were 326 feet lineal, or about 40 per cent. of its length, of which the gradients varied from 1 in 30 to 1 in 31. Taking both granite pavements, this indifferent gradient was 22 per cent. of their entire length.

Wood.—On the wood pavements the gradients south of Arthur street were excellent. In the vicinity of King William statue there were various lengths, amounting to 12 per cent. of the total length of the wood, which had gradients of from 1 in 30 to 1 in 37. Moreover, in the vicinity of the statue, where the direct gradients were the worst, the pavement at several places had transverse slopes, varying from 1 in 20 to 1 in 38. Nearly the entire surface between Eastcheap and a short distance south of the statue had objectionable cross gradients.

From what has been stated as to the effect of gradient, it was not to be expected that accidents would be traceable to gradients less steep than 1 in 60. The observations do not show that accidents increased in regular proportion as the gradients became sharp, whether above or below 1 in 60; but they indicate that when the gradients were from 1 in 30 to 1 in 50 a larger proportion of accidents occurred both upon the granite and wood than elsewhere on the same lines where the gradients were better.

Thus the mean of the 50 days' observations showed that a horse might be expected to travel 103 miles before falling on the western end of Cannon street, where the gradients were 1 in 30 and 1 in 31, assuming it to have traveled both uphill and down-

hill; whilst eastward in the same street, where the gradients varied from 1 in 61 to 1 in 841, it might be expected to travel 187 miles before it fell. The mean of all the granite pavements gave a distance of 132 miles before an accident happened to a horse.

It was shown that in Cannon street accidents on the inferior gradients oftener occurred to horses going uphill than to those going downhill.

The observations, it is true, show an excess of accidents on the granite at some parts where the gradients were better than those just referred to; as, for example, at the western end of King William street, by the church of St. Mary Woolnoth, which had a gradient of 1 in 54; but there the excess was probably attributable to the state of repair of the surface, in conjunction with the speed of travel in that thoroughfare, and also to its immediate proximity to the asphalt.

On the wood pavement in the vicinity of the statue, where the gradients were 1 in 30 and 1 in 37, and where the objectionable cross gradients existed, the records are mixed with those referring to adjoining lengths of roadway having gradients of from 1 in 30 to 1 in 260; but the average of the whole shows that a horse might be expected to travel in that neighborhood 244 miles before it fell, whereas on that part of the pavement which lies between the statue and London bridge, on which the worst gradient was 1 in 56, the distance which a horse might be expected to travel was 784 miles.

The accidents on the Ligno-Mineral pavement in Gracechurch street were at the rate of 1 in 58 miles. There the gradient was 1 in 49. If any accidents may have been attributable to this gradient, it can not alone account for the large number occurring at this spot.

The asphalt pavement was, therefore, as regards gradients, more favored than the others. The next in order was the granite. The wood pavement was, on the whole, the least favored.

EFFECT OF CONDITION OF SURFACE REPAIR.

The state of repair of the surface of a pavement affects its safety. For instance, more horses may be expected to fall on a granite pavement that has many sunken places, and the general surface of which is worn smooth, which is the condition of nearly all granite pavements when they need relaying, than on one which has an even surface and is somewhat rough to the foot, which is the condition of a *new* granite pavement.

It has already been stated that the surfaces of both the asphalt and the wood were in excellent condition, and that those of the granite were not. Cannon street was not, however, in such a state as to lead to the belief that the accidents taking place in it were materially attributable to the state of repair; but the pavement in King William street being under order to be renewed, was undoubtedly in such a state as may have caused some, for neither the traffic nor the gradient can have caused the excess of accidents that occurred in that portion of the street where the pavement was in the worst condition.

Had the wood pavements been in an indifferent condition of surface repair more accidents would probably have taken place on them than actually occurred during the 50 days' observations.

As regards asphalt the case is somewhat different. Asphalt is not likely at any time so to vary in condition as to increase materially the number of accidents taking place on it. If holes show themselves of any size or depth in this material, and they be not speedily repaired, they are quickly enlarged by the traffic, and the destruction of the pavement at those spots soon follows. It will be absolutely necessary to keep at all times the surface of the asphalt comparatively smooth, and therefore the number of accidents taking place on it is not likely to be increased by condition of surface repair.

In comparing the results of the observations for general application, it must then be borne in mind that in respect of surface repair the asphalt and the wood were more advantageously placed than the granite.

EFFECT OF SURFACE CLEANLINESS.

The thoroughfares of the city of London are now, speaking generally, perhaps as clean as streets of so much traffic can be kept, except by washing them daily. Cleanliness has a very important influence on the slipperiness of all pavements. Its effect, however, differs materially, in some cases being favorable, in other cases unfavorable to foothold, this quality depending largely on the moisture of the surface. A description of the way in which the streets were cleansed during the observations has been given in a previous part of the report.

As an example: For safety asphalt generally can not be too clean, but a granite pavement when very clean may, under certain atmospheric conditions, be much more slippery than when dirty. If clean there are occasions when the iron from the horses' shoes and from the tires of the wheels is caught by the surface of the stones, which then acquires a metallic appearance; the pavement is then most slippery. If it be not clean the dust or dirt interposes as a medium between the surface and the horses' feet, and the slipperiness is in a certain degree prevented.

A similar metallic appearance may be noticed on asphalt in very dry and cold weather if the roadway be kept clean, and it is observable especially at night. But this condition does not appear materially to affect the slipperiness of the asphalt, or certainly not nearly in the same degree that it does granite.

On the other hand, if granite be dirty and the dirt be slightly damp, it is more slippery than when clean and slightly damp. Asphalt is similarly affected, but in a very much worse degree.

The safety of wood is little affected, whether it be clean or not, so long as the surface is dry. If dirty, wood becomes just after rain much more slippery than at any other time, which is not the case if it be perfectly clean.

These remarks on surface cleanliness are made because many of the accidents occurring on the granite pavement during the 50 days' observations would certainly not have taken place had the pavement not been kept so clean. Similar cleanliness was beneficial to the other pavements. On the whole, the cleanliness under the circumstances to be narrated in the section which treats of the effect of weather on the surface, will be seen to have placed the granite at a disadvantage compared with the other pavements.

THE EFFECT OF WEATHER ON THE SURFACE.

The surfaces of all pavements are largely affected by the weather. A cold dry wind, a hot sun, a heavy or a light rain, a thick fog, or even a very moist atmosphere, causes them to be more or less slippery, according to the character of the pavement, and other conditions. Moisture plays a very important part in the safety of traveling. For example: During a continuation of a cold, dry wind, with a somewhat hot sun (an atmospheric condition prevailing largely in the spring), neither asphalt nor wood is slippery, whilst granite, if it be worn smooth, which is its ordinary condition in London, and if it be clean, is in its very worst state of slipperiness. If light rains ensue the slipperiness of the granite is much reduced; the wood will then enter into its most slippery state, but for a short time only; as the mud soon begins to peel from the surface, whilst the asphalt becomes for a time almost as slippery as a pavement can be, times of frost or snow excepted, and continues so until the mud becomes nearly liquid. If the rain falls heavily the granite becomes in its safest condition; the asphalt much safer than when merely damp; and the wood approaches in safety its condition when actually dry.

Again, as soon as fine weather comes after much rain, the street dirt clings to the surface of the wood on account of that material retaining moisture; but the wood

does not always become slippery whilst this process is going on. The mud in the joints of the granite retains its moisture for a long time if the atmosphere be damp, and causes that pavement for a certain time to be more slippery than when wet. Asphalt, which from its impermeability soon dries, enters again quickly into its safest state, but not until it has passed through an intermediate stage between wetness and dryness, during which it is quite as slippery as when rain first falls on it after drought; unless, indeed, the rain has fallen heavily and washed it perfectly clean.

It must therefore be understood that these conditions of slipperiness are subjected to manifold changes, according to the condition of the weather and the state of cleanliness of the surface of the pavement.

With a view of ascertaining how the number of accidents was affected by the moisture on the surface, observations on that head were recorded throughout the day and also each time an accident occurred. Owing to the many gradations between positive dryness and positive wetness, and the condition of each surface varying many times during the day, uniformity of description was not obtained in the records. Nevertheless the records admit of the accidents being arranged generally under certain classes of surface moisture, and of some general approximate results being arrived at.

It is then of importance in judging of the relative safety of the different pavements to give consideration to the state of the weather whilst the observations were in hand, in order to see whether it was such as was likely to be more favorable to one pavement than another. Indeed, without full consideration of this point all conclusions as to the relative safety of the pavements would be fallacious; the subject of the weather will, therefore, be treated more fully than it has yet been.

As regards wind, its direction frequently shifts for short periods during the 24 hours; and there are, therefore, various directions recorded during one day. This was the case during the period of the observations of accidents, as will be seen by Table E. Examination shows that the wind was either from the east, northeast, or southeast during a large proportion of the time; being in fact in those directions on 38 days out of 50, or 76 per cent. of the whole.

During the 50 days' observations there was, according to the registrar-general's returns, about 18 per cent. less than the usual proportion of rainy days, taking the average of the year, and about 14 per cent. less than the average during the same months. The police returns of the number of wet days is still less, inasmuch as they only recorded the rain when it fell during the 12 hours' observations, but what is even more important is that the quantity of rain was very noticeably less, inasmuch as it was but about 53 per cent., or little more than one-half of that which usually falls in the same time at that season of the year. Moreover, a considerable portion of it fell during the night when the observations of accidents were discontinued. It must above all be noticed that there was an almost entire absence of days in which rain fell at intervals in small quantities, or drizzling, although such days are very frequent in London during the year.

As regards temperature, it was a trifle lower than the average of years, and the atmosphere was on but few occasions much charged with moisture. The weather was in fact, in its main features, quantity of rain excepted, that which usually occurs in London in the spring, when dry winds are accompanied by a warm sun, owing to which moisture soon passes away from street surfaces.

The weather, therefore, on the whole was very favorable to asphalt, there having been a great absence of that weather which creates a damp surface and causes that material to be in its most slippery state, and was very unfavorable to granite, inas, much as that material, if clean, during dry, cold winds is in its most slippery condition. As regards wood, the absence of rain was decidedly favorable to it, although moisture does not appear to render that material relatively so slippery or to play so important a part as regards safety as it does with asphalt and granite.

Table E in the appendix shows the accidents which took place under different conditions of surface moisture. The general results are:

Mean of the 50 days' observations, including all those conditions of weather and surface moisture which occurred during that time.

Situation.	Distance traveled before a horse fell.
	Miles.
Granite—King William street and Cannon street	132
Asphalt—Cheapside and Poultry	191
Wood—King William street and Gracechurch street	330

These results have been given before, but are repeated here for facility of reference.

Separating the accidents under three heads, namely, those which occurred when the pavements were dry, those which occurred when they were merely damp, as during very slight rain and after rain had ceased, and after the streets had been watered, and those which took place either when rain was falling or whilst the surfaces were wet, the following results were obtained:

Table showing the comparative slipperiness of the various pavements under three different conditions of surface moisture.

Situation.	Description of pavement.	Distance traveled before a horse fell.
		Miles.
Days when surface of pavements was generally dry:		
King William street and Cannon street	Granite	78
Cheapside and Poultry	Asphalt	223
King William street and Gracechurch street	Wood	646
Days when the surface of the pavements was damp in different degrees:		
Cheapside and Poultry	Asphalt	125
King William street and Cannon street	Granite	168
King William street and Gracechurch street	Wood	193
Days when the surface of pavements was wet:		
Cheapside and Poultry	Asphalt	192
King William street and Gracechurch street	Wood	432
King William street and Cannon street	Granite	537

The following table groups the results in a different order:

Table showing the degree of slipperiness of each pavement under three conditions of surface moisture, beginning in each case with that condition under which the pavement was the most slippery.

	Falls.	Miles.
Asphalt:		
1st. When pavement was damp in different degrees	1	125
2d. When pavement was wet	1	192
3d. When pavement was dry	1	223
Granite:		
1st. When pavement was dry	1	78
2d. When pavement was damp in different degrees	1	168
3d. When pavement was wet	1	537
Wood:		
1st. When pavement was damp in different degrees	1	193
2d. When pavement was wet	1	432
3d. When pavement was dry	1	646

The following table groups the results in another order:

Table showing the slipperiness of all the pavements under various conditions of surface moisture which occurred during the 50 days' observations, beginning with the most slippery.

Situation	Description of pavement.	Distance traveled before a horse fell.	Condition of surface as regards moisture.
		Miles.	
King William street and Cannon street	Granite	78	Pavement dry.
Cheapside and Poultry	Asphalt	125	Pavement damp.
King William street and Cannon street	Granite	168	Do.
Cheapside and Poultry	Asphalt	192	Pavement wet.
King William street and Gracechurch street	Wood	193	Pavement damp.
Cheapside and Poultry	Asphalt	223	Pavement dry.
King William street and Gracechurch street	Wood	432	Pavement wet.
King William street and Cannon street	Granite	537	Do.
King William street and Gracechurch street	Wood	646	Pavement dry.

From the foregoing summaries it appears—

That asphalt was most slippery when merely damp, and safest when perfectly dry; that a horse might be expected to travel on the asphalt without an accident nearly twice the distance when the pavement was dry that it could do when damp, and that the difference between the safety of asphalt when wet and dry was not considerable.

That granite was most slippery when dry, and safest when wet; that a horse might be expected to travel on granite without accident nearly seven times the distance when the pavement was wet than when dry, and that the granite was about twice as safe when merely damp as when dry.

That wood was most slippery when damp, and safest when dry; that a horse might be expected to travel on the wood more than three times the distance when the pavement was dry than when damp, and that the wood was more than twice as safe when wet as when damp.

Here it will be convenient to show the difference between the slipperiness of the two wood pavements under observation.

About 1,394 feet lineal, or 94 per cent. of the entire length of the wood, was that of the improved wood pavement. The remaining 87 feet lineal, or 6 per cent. of the whole, was the ligno-mineral pavement.

It will be seen that altogether 380 horses fell on the improved wood pavement, and 162 on the ligno-mineral pavement. Dealing with these figures in the same manner as before, we find that a horse might be expected to travel before it met with an accident 446 miles on the improved wood pavement, and 58 miles on the ligno-mineral pavement. In other words, the improved wood was nearly eight times safer than the ligno-mineral under such conditions of weather and traffic as took place during the 50 days' observations.

The ligno-mineral pavement had a gradient of 1 in 49, which was certainly not so good as a considerable length of the other pavement, but the improved wood had 267 feet in length with gradients varying from 1 in 30 to 1 in 37, which are very much worse for traction than 1 in 49. In addition to this, it had the disadvantage of the bad cross gradients, and it is evident, therefore, that gradient can not account for the large proportion of falls which occurred on the ligno-mineral pavement.

The traffic on both of the pavements was much the same in character, and passed at about the same speed; and as the surfaces of both were in very nearly equally good repair, one was not more disadvantageously placed than the other in these respects.

Many omnibuses turn round on the ligno-mineral pavement to take up their station on the eastern side of Gracechurch street, and it was at first imagined that accidents might have been attributable to that cause. On looking into the matter, it was found that the omnibuses were for the most part empty, or nearly so, and that they

turned round slowly, so that accidents did not occur to their horses in any larger proportion than to the other traffic. Even if some accidents were caused by this, they would not account for the excess.

It is important to separate these accidents. If those which occurred on the ligno-mineral are eliminated, and those which occurred on the improved wood are alone used for comparison with the asphalt and granite, it will be seen (as shown in Table F in the appendix) that a horse might have been expected to travel during the 50 days' observations 446 miles on the improved wood pavement before it met with an accident, instead of 330 miles as shown by the summaries, in which both woods are taken together, and that the order of slipperiness would therefore be—

	Miles.
1. Granite	132
2. Asphalt	191
3. Wood	446

CONCLUDING REMARKS.

A consideration of those sections of the report in which the pavements are referred to under the various conditions that affect their slipperiness shows how wrong it would be to take the first broad results of the observations as an exact measure of the relative safety of the pavements at all times and seasons. It would not, however, be possible to substitute for the results now placed before the commission anything in a similarly exact shape, unless observations were taken over the three classes of pavements in other seasons of the year. All that now can be done is to take the figures given by the 50 days' observations, and after studying them by the side of those modifying circumstances which have been set forth in the various sections of the report, to draw such general conclusions as may seem to be warranted.

The first thing, therefore, is to consider the effect of those conditions in which one pavement was more favorably placed than the others. Conclusions on these points have been given in the sections in which they have been separately treated of, and taking them in the order of the report their general results are as follows:

As regards the effect of the speed of traffic, the wood and asphalt were as nearly as possible under similar conditions. The granite, having at one place a higher speed, and the pavement there not being in so good condition as the others, was placed in less favorable circumstances.

As regards gradient, the asphalt was the most favorably placed, the granite the next so, and the wood the least.

As regards surface repair, the asphalt and the wood were in equally good condition, while the granite was in a very inferior condition.

As regards cleanliness of surface, all three pavements were equal so far as the materials of which they were composed enabled them to be.

As regards weather, it was very much in favor of the asphalt, was generally favorable to the wood, and was very unfavorable to the granite.

Taking the whole group of conditions into account, the asphalt was the most advantageously placed, the wood was the next so, and the granite was the worst placed.

On the average of the whole 50 days' observations the granite was found to be the most slippery, the asphalt the next so, and the wood the least.

Separating the accidents under three conditions of surface as regards moisture, it appears:

That asphalt was most slippery when merely damp and safest when dry.

That granite was most slippery when dry and safest when wet.

That wood was most slippery when damp and safest when dry.

That when the surface of the pavements was generally dry granite was the most slippery and wood the least slippery.

That when the surface of the pavements was damp in different degrees asphalt was the most slippery and wood the least slippery.

That when the surface of the pavements was wet asphalt was the most slippery and granite the least slippery.

That on the whole wood was less slippery than either asphalt or granite.

That if the observations on the ligno-mineral paving be eliminated, and the improved wood pavement alone taken for comparison, wood was on the whole less slippery than either asphalt or granite in a marked degree, it only being inferior to granite when the pavements were wet, and the difference then between the wood and the granite being inconsiderable.

That of those accidents which are most obstructive to the traffic as well as most injurious to the horses, asphalt had the greatest proportion, granite the next, and wood the least.

That the greatest proportion of accidents on all the pavements was to horses in vehicles drawn by three or more horses.

That had the granite been under as favorable conditions as the asphalt and the wood the results would have been more in favor of the granite, although to what extent can not be stated.

Finally, I beg to state that it would be desirable to make observations at a different season of the year to that in which those herein recorded were taken.

I have the honor to remain, gentlemen, your most obedient servant,

WILLIAM HAYWOOD,
Engineer and Surveyor.

ASPHALT PAVEMENTS IN LONDON.

SEWER OFFICE,
Guildhall, April 18, 1873.

To the streets committee of the honorable the commissioners of sewers of the city of London:

GENTLEMEN: In pursuance of your instructions I have carefully inspected the whole of the asphalt pavements which have been laid within the city of London, and beg to lay before you my report upon their present condition.

I have put my report in the shape of a table, which gives the dates when the pavements were laid, their area, first cost, the traffic which passes over them, and other particulars which may be found useful in considering questions relating to asphalt pavings generally.

Portions of some of the pavements have been cut out under my direction, in order to ascertain whether they had lost materially in thickness. In nearly all cases a slight diminution in thickness was found to have taken place, and in one instance to such an extent as to lead to the inference that it could not have been properly compressed when laid, or that it was not laid of the depth intended; in one or two instances, on the contrary, the thickness was found to be the same or even greater than that at which they were nominally laid. Taking, however, into account the position in which the various openings were made for examination, and the circumstances which affect the consideration, there is no doubt that the asphalts have somewhat diminished in thickness under the wear of the traffic, but owing to inequalities when they were first laid, and to the compression which takes place in all those laid in the shape of heated powder, it would be difficult to ascertain the exact loss without making a very large number of openings.

The asphalt companies upon application to them have given some account of the repairs done since the pavements were laid, but not in such a shape as it would be desirable to have it; it is, however, I have reason to believe, the best account that they can give.

Reports from the inspectors of pavements have also been made to me, an abstract of which report is given in the table, those officers having long since been directed by me to notice carefully the repairs which were made to the pavements; but the

companies being bound to maintain the pavements for a given number of years, can repair them whenever they think needful, without consulting me, provided they do not interfere with the traffic in their operations, and as repairs are generally performed at night, or very early in the morning, it is possible that many may have escaped the notice of the inspectors.

In considering the table, the following explanations should be held in view:

Where a pavement is stated to be in a generally good condition, no account is taken of the transverse depressions in the compressed asphalts or of the lines of joint in the other asphalts consequent upon the mode of laying or forming the pavements.

In compressed asphalts repairs after a time are not readily noticeable, whilst those in mastic asphalts are more easily seen.

Where "holes" or "short holes" are mentioned, it must be understood that the asphalts are not worn down to the concrete foundation.

Minute holes are noticeable in compressed asphalts shortly after they are laid, which holes after a time seem to close up or disappear, whilst others open; the cause of this (which is probably due to foreign substances) has never been satisfactorily explained, but no account is taken of these small holes in my report as to condition.

The larger holes upon compressed asphalts are in most cases depressions *caused by* the traffic, and do not necessarily indicate surface wear; in the mastic asphalts, on the contrary, they are for the most part the result of disintegration and wear of the surface.

There are now altogether twenty-five streets or portions of streets in the city of which the carriageways have been paved with asphalt; one of the pavements had been down 3 years and 9 months, two for 2 years and 2 months, eighteen under 2 years, four under 1 year, and 5 under 6 months, at the time of my inspection.

I have the honor to remain, gentlemen, your most obedient servant,

WILLIAM HAYWOOD,
Engineer and Surveyor.

Table showing the various asphalts which have been laid in carriageways within the city of London, April, 1873.

Name.	Date.	Total carriage-traffic from 8 a. m. to 8 p. m.	Area.	First cost of pavement including foundation, per yard superficial.	Laying was completed.	Time down, to March 1, 1873.	Returns supplied by companies as to repairs done since pavement was laid.	Inspectors' reports as to repairs since pavement was laid.	Engineer's report as to present condition and general results of examination into loss of thickness by wear and compression.
			Sup. yds.	*s. d.*		*Yrs. Mo.*			
Val de Travers asphalt. (Compressed.)									
Poultry and Cheapside:									
Poultry	July 5, 1872	7997	7938	18 0	Dec. 9, 1870	2 2¾	Total cost of repairs over the whole surface 3¾*d.* per square yard during 1872.	Is continually being repaired at night.	Poultry: Its nominal thickness when laid was 2½ in. Of two samples cut out recently the thicknesses varied from 1⅝ in. to 1 13/16 in. in the groove worn next curb, and from 1½ in. to 1⅝ in. at a distance of 3 ft. from curb; many holes over the entire surface. The channels on both sides are very much worn, and it will require extensive repairs during the year.
Cheapside	Feb. 7, 1872	8949							Cheapside: Its nominal thickness when first laid was 2½ in. In three samples cut out recently the thicknesses varied from 1 5/16 in. to 1 7/16 in the groove worn next the curb, 1¾ in. to 1 13/16 at 3 ft. from curb, and an average of 1⅞ in. in the center of the carriageway. The weight of a piece 1 ft. square was 21 lbs. 15 oz., or 197 lbs. 7 oz. per superficial yard. The channels are somewhat worn, and the entire surface of this pavement has many small holes, which have principally shown themselves within the last 6 months. Very extensive repairs will be needed during the year.
Old and New Broad streets:									
Old Broad street	Feb. 7, 1872	2473	3671	16 0	Mar. 25, 1871	1 11¼	Total cost of repairs over whole surface ⅜*d.* per square yard during 1872.	No repairs done.	Old Broad street: Its nominal thickness when laid was 2 in. Its present thickness at the center of carriage-way is 1 1/16 in., and a sample 1 ft. square weighed 19 lbs. 8½ oz., or 175 lbs. 12½ oz. per superficial yard. A few small holes, but otherwise in good condition.
New Broad street	Apr. 1, 1873	1515							
Throgmorton street, narrow portion at western end.	....do	661	150	16 0	Mar. 30, 1871	1 11	None	No repairs done.	The channels somewhat worn, the pavement otherwise in good condition.
Milk street	....do	516	297	16 0	Mar. 22, 1871	1 11¼	None	Repaired in one or two places during the year.	One or two holes on surface. Channel at one place somewhat worn, but surface otherwise in good condition.

Table showing the various asphalts which have been laid in carriageways within the city of London, April, 1879—Continued.

Name.	Date.	Total carriage traffic from 8 a.m. to 8 p.m.	Area.	First cost of pavement including foundation, per yard superficial.	Laying was completed.	Time down, to March 1, 1873.	Returns supplied by companies as to repairs done since pavement was laid.	Inspector's reports as to repairs since pavement was laid.	Engineer's report as to present condition and general results of examination into loss of thickness by wear and compression.
Val de Travers asphalt (compressed)—Continued.			*Sup. yds.*	*s. d.*		*Yrs. Mo.*			
Russia row	April 1, 1873	97	80	16 0	Mar. 22, 1871	1 11¼	None	Repaired in one or two places during year.	In good condition.
Queen street	Feb. 7, 1872	2292	799	16 0	Apr. 27, 1871	1 10	None	None of any consequence.	Its nominal thickness, when first laid, was 2⅛ in. The sample cut out averages 1⅞ in. thick, and weighs 16 lbs. 10 oz. to the square foot, or 149 lbs. 10 oz. per superficial yard. The surface is somewhat worn at the northern end, but in fair condition generally. The southern end has been cut about and damaged by alterations of gullies and pavements consequent upon widening the street.
Old Bailey	Feb. 6, 1872	2903	402	16 0	May 2, 1871	1 10	None	None	Surface generally in good condition.
Gracechurch street:									
By St. Peter's alley	Apr. 3, 1873	4824	2659	17 0	July 22, 1871	1 7½	Total cost of repairs over whole surface, 2½*d.* per square yard in 1872.	Frequently repaired at south end.	There are numerous small holes at the southern end, especially near to Fenchurch street; numerous depressions toward the northern end near to Cornhill, where the street is narrow. The surface generally is in good condition, but is not so even or good as some other of the pavements of this company.
By Ship Tavern passage	....do	4650							
Finsbury pavement and Moorgate.	Mar. 3, 1873	5361	3861	16 0	Aug. 18, 1871	1 6½	None	Trifling repairs.	There are small holes over the surface of this pavement, but it is generally in good condition.
Moorgate street	....do	6000	1028	16 0	....do	1 6½	None		The nominal thickness when laid was 2 in. The sample cut out averages 1$\frac{13}{16}$ in. thick, and weighs 21 lbs. 0½ oz. per square foot, or 189 lbs. 4½ oz. per superficial yard. There are but few small holes in this pavement, and the surface is in a very good condition.
Wood street	Apr. 4, 1873	980	1492	16 0	Sept. 7, 1871	1 5½	None	None of consequence.	There is wear in the channels throughout the street, and a few small holes, but it is otherwise in good condition.

London wall:									
By Little Winchester street.	....do	2262	3165	16 0	Oct. 18, 1871	1 4½	None	Slight repairs but none for some time past.	In the narrow portion of this street a depression is visible in the center of the carriageway throughout its length, which may be partially due to the sinking caused by excavating for a gas pipe trench. There are also some short holes over the surface, which is otherwise generally in good condition,
By Circus place	....do	2852							
Threadneedle street, near Finch lane.	Apr. 9, 1873	3696	485	(*)	May 31, 1869	3 9	None	Nine very small repairs have been made since the pavement was first laid down, their total area being 3⅔ yards superficial.	The nominal thickness when laid was: Mastic ½ in., compressed asphalt 2 in. making a total thickness of 2½ in. The first sample cut out recently, averaged: Mastic ¾ in., compressed asphalt 2¼ in, making together 3 in., and weighed 32 lbs. 15½ oz. to the square foot, or 296 lbs. 11½ oz. per superficial yard, including the mastic. The second sample taken averaged: Mastic ½ in., compressed asphalt 2 in., making together a thickness of 2½ in., and weighed 21 lbs. 6½ oz. per square foot, or 192 lbs. 10½ oz. per superficial yard, including the mastic. This asphalt appears to have been laid very irregularly in thickness. This pavement was the first laid in the city, and was done at the sole expense of the asphalt company. There are a few holes in places, but it is generally in a good surface condition.
Threadneedle street:									
Eastern end.....	....do	3696	439	16 0	Dec. 22, 1871	1 2¼	None	The portion in narrow way is frequently repaired.	When laid its nominal thickness was 2 in. The sample taken recently gave a thickness of 1 in. in the channel next the curb, and 1⅝ in. at 3 ft. from the curb, and weighed on an average 179 lbs. 9 oz. per superficial yard. The channels throughout the carriageway are deeply worn; there are two well-marked lines of depression or wear running along the center of the street where the outer wheels of the vehicles usually run. There are many depressions or short holes towards the eastern end, and generally the whole surface shows signs of much wear.
Central portion (previously laid by the Maestu Asphalt Company).	....do	3696	281	16 0	Jan. 26, 1872	1 1¼	None		
Mansell street	Apr. 7, 1873	498	734	16 0	Oct. 27, 1871	1 4	Total cost of repairs over whole surface, 3*d.* per square yard; pavement was laid in very bad weather.	One slight repair done.	A few small holes, otherwise the surface is in good condition.

* Laid by company free of charge.

Table showing the various asphalts which have been laid in carriageways within the city of London, April, 1873—Continued.

Name.	Date.	Total carriage traffic from 8 a. m. to 8 p. m.	Area.	First cost of pavement, including foundation, per yard superficial.	Laying was completed.	Time down, to March 1, 1873.	Returns supplied by companies as to repairs done since pavement was laid.	Inspectors' reports as to repairs since pavement was laid.	Engineer's report as to present condition and general results of examination into loss of thickness by wear and compression.
Val de Travers asphalt (compressed)—Continued.			*Sup. yds.*	*s. d.*		*Yrs. mo.*			
Mansion House street.....	....do	13767	3043	16 0	June 21, 1872	8½	Total cost of repairs over whole surface, ½*d.* per square yard.	Slight repairs done.	Wear in the channels next the Mansion House, and generally on the surface opposite to that building. The surface is otherwise in good condition. This pavement has been added to once, owing to widening the street.
Princes Street:									
In place of Trinidad asphalt.	Feb. 15, 1872	5, 628	340	14 8¾	Nov. 16, 1872	3½	None	None	In good condition.
In place of the patent British asphalt.	....do	5, 628	371	14 9¾	Dec. 22, 1872	2¼	....do	....do	Do.
Val de Travers asphalt (mastic).									
George yard.....	Apr. 7, 1873	58	232	12 0	Apr. 1, 1871	1 11	.....	No repairs done.	Small depressions over the surface, but it is generally in good condition.
Montrotier asphalt (compressed).									
Princes street	Feb. 15, 1872	5, 628	347	15 0	Aug. 14, 1872	6½	None	None	Nominal thickness when laid was 2¼ inches. Of two samples taken recently, the thicknesses varied from 1½ to 2 in., a square foot weighing 15 lbs. ½oz., or 135 lbs. 4½ oz. per superficial yard. The pavement is in good condition.
Société Française des asphaltes (compressed).									
Princes street	....do	5, 628	325	14 9	July 18, 1872	7½	....do	....do	Its nominal thickness when laid was 2½ in. and its present thickness varies from 2¼ to 2⅝ in., a square foot weighing 25 lbs. 12 oz., or 231 lbs. 12 oz. per superficial yard. The surface is unusually wavy, owing probably to want of skill in laying it, but it is generally in good condition.

Limmer asphalt (mastic).									
Lombard street	Feb. 25, 1872	2,499	1,153	16 0	May 18, 1871	1 9½	About 82 yards superficial ¼ to ½ inch in thickness in 1872.	Has been extensively repaired during the last 3 months, at the eastern end more particularly.	Its nominal thickness when laid was 2-in. The sample taken recently averaged 1⅝ in. in thickness and weighed 21 lbs. 2 oz. per square foot, or 190 lbs. 2 oz. per superficial yard. The channels on both sides of this street throughout its length are more or less worn; there are many short holes in the center of the carriageway, especially at the western end; some also at its eastern end near to Fenchurch street.
Moorgate street	Mar. 3, 1873	6,000	1,038	16 0	Sept. 6, 1871	1 5¾	Repairing by water-boxes about 2 yards superficial, and about 80 yards of surface renewed ½-inch thick.	Has been extensively repaired during the last 3 months.	Considerable indications of surface wear in the center of the street; a few bad holes and depressions, but in other respects the surface is good.
Cornhill	Apr. 3, 1873	3,507	3,333	15 0	Mar. 6, 1872	11¾	Laying about ½ in. on 3 yards of surface which had become depressed.	None of consequence.	There is considerable wear along the center of the carriageway upon the line which the traffic generally takes if the street is not too full. This wear has left the surface rough to the feet. The channels are slightly worn.
Barnett's asphalt (mastic).									
Moorgate street	Mar. 3, 1873	6,000	1,057	13 6	Oct. 14, 1871	1 4½	Was repaired in 1871 at its junction with the granite sets in Lothbury. Several small repairs have been done on the southern portion, which was laid during the continuance of heavy rains.	Has been extensively repaired during the year.	Its nominal thickness when first laid was 2½ in. The sample recently taken averages 2 3/16 in. thick, and weighs 23 lbs. 9½ oz. per square foot or 212 lbs. 5½ oz. per superficial yard. There are many small holes, especially at its southern end, where large repairs have been made; the lines of joint are unusually visible. This pavement towards its southern end was laid in very bad weather.
Carter lane	Apr. 4, 1873	317	757	11 6	Sept. 7, 1872	5¾	No repairs done.	None	Surface in good condition.
Lothbury	Apr. 8, 1873	1,612	2,384	10 6	Oct. 10, 1872	4⅜	Some large patches, in consequence of adverse circumstances in laying, were almost immediately relaid.	Large portions being badly laid or of bad material have been taken up and relaid, and this is still being done.	The surface is exceedingly variable, in some parts being smooth and in others rough; where rough there are signs of wear; the western portion is the worst.

Table showing the various asphalts which have been laid in carriageways within the city of London, April, 1873—Continued.

Name.	Date.	Total carriage traffic from 8 a. m. to 8 p. m.	Area.	First cost of pavement, including foundation, per yard superficial.	Laving was completed.	Time down, to March 1, 1873.	Returns supplied by companies as to repairs done since pavement was laid.	Inspectors' reports as to repairs since pavement was laid.	Engineer's report as to present condition and general results of examination into loss of thickness by wear and compression.
Barnett's asphalt (mastic)—continued.									
Bishopsgate street within...	Apr. 7, 1873	6,048	*Sup. yds.* 4,288	*s. d.* 10 6	Dec. 21, 1872	*Yrs. mo.* 2¼	None	None	There are numerous holes in this pavement and many indications of either looseness of structure in the material itself or else of wear of the surface, and this is principally in the center of the street. The eastern half of this street is rough and in such condition as indicates either materials of inferior quality to that in other portions of the street, or else very bad laying. During nearly whole time this pavement was in hand the weather was unusually wet and unfavorable, and this may in a degree account for its condition.

Table showing the various asphalts which have been laid within the city of London, April, 1873—Continued.

Name.	Date.	Total carriage traffic from 8 a. m. to 8 p. m.	Area.	First cost of pavement, including foundation, per yard superficial.	Laying was completed.	Date of removal.	Time down.	Engineer's report.
Maestu asphalt (compressed blocks).								
Threadneedle Street	July 20, 1871	3,538	*Sup. yds.* 281	*s. d.* 12 0	Dec. 11, 1871	Jan. 26, 1872	*mo.* 1½	This pavement was laid upon inferior concrete; it was repaired once, but was ultimately removed about 1½ months from time it was put down. It was replaced with the Val de Travers compressed asphalt.
Trinidad asphalt (compressed).								
Princes street (south end, next to Mansion House street).	Feb. 15, 1872	5,628	340	10 8	June 19, 1872	Nov. 16, 1872	5	This pavement showed signs of wear directly it was opened to the traffic; it was repaired continually, but cut to pieces, and it was removed at the end of 5 months. It was replaced with Val de Travers compressed asphalt.
Patent British asphalt (mastic).								
Princes street	Feb. 15, 1872	5,628	371	12 0	July 6, 1872	Dec. 22, 1872	5½	This showed signs of wear soon after it was used. The traffic pulverized it; it was extensively repaired, but was removed at the end of 5½ months. It was replaced with Val de Travers compressed asphalt.

APRIL 18, 1873.

WILLIAM HAYWOOD.

WOOD AND ASPHALT PAVEMENTS IN LONDON.

SEWERS OFFICE,
Guildhall, March 17, 1874.

To the Honorable the COMMISSIONERS OF SEWERS OF THE CITY OF LONDON.

GENTLEMEN: The reference to me upon this subject is as follows:

"To report fully as to the relative advantages of wood and asphalt for paving purposes, together with the probable expense and durability of each."

I beg in the first place to lay before the commission some information respecting the wood and asphalt carriage-way pavements laid up to the present time in the city.

Wood.—The first wood pavement was laid in the Old Bailey in 1839, and was quickly followed by many others; they were of considerable variety, some being simple in structure, others very complicated, and none of them lasted more than 7 years. The streets were then not cleansed as well as they now are, which was disadvantageous to the wood, nor was the mode of preserving the surface of the wood well understood. Experience in the cost of pavements was almost entirely confined to those formed of granite, of a superior quality to that which now comes to London, and of stones more than double the size of those now generally used; and as the duration of some of the wood pavements was so small, and their cost much larger than granite, a prejudice appears to have arisen against wood, and the pavements as they wore out were for the most part replaced with granite.

Wood was, however, retained in Mincing Lane, Gracechurch street, Cornhill, Lombard street, Bartholomew Lane, Lothbury, and in part of the Old Bailey, until within the last 3 years, when, with the exception of that in Bartholomew Lane, it was replaced with asphalt.

The wood pavements more recently laid, and existing in the city thoroughfares at the end of 1873, with other information respecting them, are shown by the following table:

TABLE NO. 1.—*Table showing the lengths and areas of the different wood pavements in the city of London on December* 31, 1873.

Pavement.	Length.	Superficial area.
	Yards.	*Yards.*
Carey's	134	946
Improved wood	701	9,545
Ligno-mineral	27	410
Mowlem's	171	1,053
Stone's	26	284
Total	1,059	12,238

Asphalt.—The first pavement was laid in Threadneedle street in May, 1869, and was formed of the compressed asphalt of the Val de Travers company. Cheapside and the Poultry were laid with similar asphalt in the autumn of 1870, and many thoroughfares have since been paved with it and asphalts of other kinds. Those in the city thoroughfares at the end of 1873, with other information respecting them, are shown by the following table:

TABLE No. 2.—*Table showing the lengths and areas of the different asphalt carriage-way pavements in the city of London on December* 31, 1873.

Pavement.	Length.	Superficial area.
	Yards.	*Yards.*
Val de Travers (compressed)	4,185	34,876
Val de Travers (mastic)	69	232
Limmer (mastic)	1,446	8,477
Barnett's (mastic)	1,705	16,544
Société Française (compressed)	39	327
Montrotier (compressed)	40	346
Total	7,484	60,802

No two pavements, whether of asphalt or wood, are exactly similar in their qualities, nor will they be of the same durability or cost. It may be necessary specially to refer to some, although for the most part the remarks in this report will be applicable to asphalt and wood generally. Nevertheless, as it is needful to make direct comparison upon some points, I select for that purpose the compressed asphalt pavement of the Val de Travers Company, and the improved wood pavement, as being the best examples of their several kinds, and of which there are the largest quantities now laid in the city, and elsewhere in the metropolis. The following is a brief description of them:

The compressed asphalt pavement of the Val de Travers Company is formed of a natural material, procured from a mine in Switzerland; it is laid upon a bed of cement concrete, in a state of heated powder, and so as to be, when compressed, from 2 to 2½ inches in thickness, according to the traffic of the street.

The improved wood pavement is formed of fir blocks, 3½ inches wide, 10 inches long, and 6 inches deep, laid upon a foundation of two thicknesses of fir planks, well pitched and nailed together; the blocks are placed close together at their short ends, but on their longer sides are joints, running from side to side of the street, three-fourths of an inch wide, the lines of joint being kept by fillets nailed to the planks; the joints are filled up with clean small pebbles, rammed in, and then run with a composition formed of pitch, tar, or other bituminous substances.

It may be observed with regard to asphalt, that although there is much larger experience in its use than there was in 1871, when I reported upon the comparative merits of asphalt and granite pavements, I see no reason upon most points materially to alter the views and opinions therein expressed, and much then said will be repeated in the present report.

I take up the consideration under the same heads adopted in the report of 1871 upon granite and asphalt, varying only slightly their order, which will here be: (1) Convenience; (2) Cleansing; (3) Construction and Repair; (4) Safety; (5) Durability and Cost.

CONVENIENCE.

The principal, if not the sole object in London of employing either asphalt or wood for carriage-way pavements is to diminish the noise of the traffic.

Asphalt is less noisy than granite, for, being smooth and without joints, the wheels of vehicles run almost as easily over it as they do on a street tramway, and what noise is caused by the traffic comes almost entirely from the clatter of the horses' feet upon the asphalt.

Wood is less noisy than asphalt, the horses' feet making no clatter upon it; in fact, wood makes the most quiet of all known pavements.

Asphalt can not be suffered to get materially out of repair, for if it does it is speedily knocked to pieces, therefore, the quietness and the comfort it affords will be at all times nearly the same.

Wood pavements being composed of blocks of different sizes and jointed in different manners, are in the course of time worn into inequalities of surface, and when in that condition carriages are more jolted and there is more noise than when the pavements are new, but this is principally experienced by those inside the carriages.

The extent to which this irregularity of surface takes place depends much upon the care taken in its maintenance, but also upon the nature of the pavements; those formed of large blocks with wide joints wear more unevenly than those of small blocks with close joints. The owners contend that their improved wood pavement, having no short joints, and the blocks reposing upon a slightly elastic foundation, will not wear unevenly, and probably it will wear more evenly and last longer than any other wood pavement yet laid, but it certainly will wear somewhat round in the direction of the traffic.

There is a rumbling noise noticeable when inside a carriage driven quickly over this pavement which I never observed upon others, and is thought by some to be disagreeable. The cause is probably owing to the compactness of its structure, its extreme regularity of surface, and the elasticity of the foundation. Should the extreme regularity of surface disappear the noise will, I think, diminish. This noise, however, only affects those inside vehicles; in other respects it is as quiet as other wood pavements.

Pedestrains, where the carriage traffic admits of it, walk largely upon asphalt, owing to its smoothness, cleanliness, and dryness. As far as I have observed, they do not walk so much upon the wood.

Asphalt being impervious to moisture, water runs off it quickly or is soon evaporated. Dirt lingers in the joints of wood pavements and is worked out by the traffic, making the surface dirty for some time after rain. Where carriageways are dry and clean the footways are usually clean, for in narrow streets of much traffic most of the dirt upon the footways comes from the carriageways. The relative advantages of the two pavements in this respect depend, however, largely upon the care taken in cleaning.

Wood absorbs moisture and is frequently damp when asphalt is dry; but if it be reasonably clean, the dampness does not affect the safety or comfort of the traffic. When dry weather ensues after rain, dirt clings to the wood, and there is no dust for some time.

It has been said that wood pavements at times smell offensively, and may be unhealthy; but although some city streets have been paved with wood for 30 years, no complaints that I am aware of have been made to the commision on this head, and the inhabitants at all times have not only expressed great anxiety lest the wood should be replaced by other material, but have subscribed toward the cost of its renewal. In the northern towns of Europe wood pavement is much used. In America and Canada many of the largest cities are paved almost entirely with wood, and it is not there believed to be unhealthy. I have at times noticed offensive emanations from it near cab stands, but am unable to find other evidence of its unhealthiness. These remarks must be held to apply only to public streets open to sun, air, and traffic; in confined places, and under some conditions, wood might be objectionable. I have seen it decaying in confined places without traffic.

It may be desirable to refer to the question whether wood pavements are likely to be the means of spreading a conflagration. It was found by experiments made by me for the commission, in conjunction with Captain Shaw, chief officer of the fire brigade, that asphalt, subject to a more severe test than it would be in the case of an ordinary fire, would not aid in spreading a conflagration, and there is no reason to suppose that wood would be more likely to do so, laid, as it is, under conditions rendering surface ignition improbable. At Chicago the foot pavements were, in many cases, formed of planks laid on wooden joists, the whole structure being 1 or 2 feet above the carriageway, and subject to the action of the fire on both sides, but it is doubtful whether the fire was materially, if at all, increased by those footway pavements.

Asphalt and wood have therefore each in some respects advantages which the other does not possess in an equal degree. On the average of its life asphalt is the smoothest, the dryest, the cleanest, the most pleasing to the eye, and on the whole the most pleasant to travel over (apart from the question of safety), but in respect of quietness to the inhabitants and street traffic wood is superior to asphalt.

CLEANING.

Both asphalt and wood should be kept very clean for safety, but great cleanliness is more important to asphalt than it is to wood.

Asphalt can be kept cleaner than any other pavement, for, being nonabsorbent and without joints, the broom, the scraper, the shovel, or water can be applied to it most effectively. Wood pavements are most difficult to clean on account of the joints and the absorbent nature of the material. The Improved Wood Pavement Company has recently kept the carriageways of King William street and Ludgate Hill (temporarily committed to their charge) in a state of cleanliness never before attained on wood. The cost of this work I am unable to state.

Experiments made under my direction in 1867 and in 1873 in washing granite and asphalt with jet and hose showed that asphalt cost slightly less than granite, but that a higher state of cleanliness can be obtained on it. It is probable that the cost of washing wood would also be more than that of asphalt. Washing is the best way of cleansing all pavements, and it is desirable that an experiment be made on wood at an early opportunity.

The moisture left on the surface of asphalt by washing makes it slippery, the duration of the slipperiness depending upon the care taken in drying it and on atmospheric conditions. Moisture does not leave wood slippery if it be clean. Moisture, although visible, is frequently rather in the wood than on its surface, a fact to be held in mind when considering this point.

Watering to lay the dust on asphalt is not done in the city, much care being taken to keep the pavements clean by constant removals of the refuse. Statements have been made that a fine dust arises from it which is obnoxious to traders having fine goods, but some dust is unavoidable in streets of great commerce and traffic, whatever may be the pavement or the mode of cleansing adopted. Watering asphalt is objectionable on account of the temporary slipperiness it creates, and as the surface soon dries at the season of the year when there is the most dust, watering, to be useful, should be almost continuous.

Wood pavements as at present cleansed require watering, for dirt clings to them more than to the asphalt. If washed daily and the street-orderly system be employed during the day, it is just possible watering might be dispensed with, but I am by no means sure of that.

Asphalt, when laid or repaired, is fit for the traffic a few hours afterward; it is left clean and causes no inconvenience from dirt or dust.

Wood, when newly laid or when repaired, is covered with fine gravel or grit of some sort, which should lie upon it some days. This grit being pressed into it by the traffic, indurates and preserves the surface. For the same reason it is desirable several times a year to strew the surface for a day or two in a similar manner, and at those times the pavement is dirty. It is not, as a rule, necessary to strew wood with gravel to prevent slipperiness, although there are occasions when it is useful to do so. With present experience it is necessary to strew asphalt with sand when the surface is slightly damp and there is much traffic in the street.

Upon the whole I consider that wood may be kept cleaner than it hitherto has been, but that whatever be the process adopted it will be more difficult and expensive to keep clean than asphalt that the moisture from watering, which leaves asphalt slippery, affects wood less objectionably (as will be seen when the question of safety is dealt with); that there is necessity upon occasions for strewing the surfaces both of asphalt and wood with sand or gravel; that the sanding of asphalt

must be more frequent than the graveling of wood; that the graveling of wood for the time renders the streets more dirty than the sanding of asphalt does, but that the degree of inconvenience from both these operations depends upon the care with which they are performed.

CONSTRUCTION AND REPAIR.

Cheapside and the Poultry were laid with compressed asphalt, together with the concrete foundation, at the rate of 129 yards per day; Ludgate Hill was laid with the improved wood pavement, including the removal of earth for the plank foundation, at the rate of 125 yards per day; other wood and asphalt pavements can be laid as expeditiously. These remarks apply to fine weather. In wet weather neither the concrete foundation nor the asphalt can be laid. Wood blocks, if not requiring a concrete foundation, can be laid in most weathers, but the grouting of the joints, whether with lime or asphalt, can not be properly done unless the weather be reasonably dry. The same remarks apply to repairs both to asphalt and wood in respect to weather.

Very small surface repairs can be made with facility in all asphalts. In compressed asphalt they can be made so neatly as not to be noticeable after a short time but in the mastic asphalts the joints remain visible.

The ease with which repairs can be made to a wood pavement depends upon it, character. Ordinarily they can be done with the same facility, and are executed in much the same manner as to granite. Repairs to the improved wood pavement are differently performed and require some descr iption. The plank foundation is cu through, the line of cut in the two layers being at different places; a third board is then first laid beneath the lowest planking so as to break the joint; the two layers of planking are then relaid and spiked together, the fillets and blocks being replaced and grouted in the usual manner. Although the continuity of the original planks is thus destroyed the repair seems to be done with ease, and as far as experience goes is sufficient for all practical purposes; but I think the repairs take a somewhat longer time than the ordinary wood pavements.

Repairs have been made over pipe trenches in King William street, Great Tower street, and Bartholomew lane, the surface in all cases has been well restored, and the work was done quickly. This pavement is referred to at some length, it being in structure different from any others yet laid in the city, and, therefore, needing explanation.

Taking seasons and weather generally into account, asphalt and wood can be laid and repaired with equal expedition, but repairs to wood pavements generally are not so permanent as those to asphalts, usually also it is necessary to take up a much larger surface in wood to make a good repair than it is in asphalt, which can be cut out to the exact size needed. In this respect asphalt has a decided superiority over wood

SAFETY.

The safety of a pavement is a matter of importance everywhere, but especially so in narrow thoroughfares of great traffic, where accidents also cause inconvenience to the general traffic.

Observations made at Paris some years ago in two streets, one paved with the hard sandstone, much used in that capital, and the other with asphalt, showed that in the street paved with stone one out of every 1,308 horses fell, and in that paved with asphalt one out of every 1,409 horses fell.

The city police in 1871 made observations, from which it was found that about six horses fell daily in the length of Cheapside and the Poultry, or at the rate of one out of every 2,323 passing along those thoroughfares. The same year I made inquiries into the slipperiness of asphalt, and took the opinions of various persons who from their occupations had special opportunities for forming correct judgment upon the

point, and on consideration of the information then obtained there appeared to be good reason for believing that on the average of the year asphalt was not more slippery than granite.

There were, however, at that time but two or three streets paved with asphalt, and alternate routes paved with other material were open to the traffic. Complaints of the slipperiness of asphalt have increased since its use has been extended, and although allowance must be made for the prejudice which generally exists against any new class of pavement (there was a time when loud complaints were made of wood being much more slippery and dangerous than granite), some of the statements made to the commission are entitled to consideration.

Among them was a petition presented in July last signed by twenty-four horse owners, including the London General Omnibus Company, two of the largest English carriers, the managers of three railways, and cab and omnibus proprietors. Sixteen of the petitioners stated that they owned amongst them 13,448 horses, of which the London General Omnibus Company owned 8,000; the remaining fifteen owned 5,448, or an average of 363 horses each. The petitioners, after stating that in their opinion asphalt pavement was objectionable as compared with granite, and that horses were quickly deteriorated by traveling over it, prayed the commission "that no more of such paving shall be laid down in the principal thoroughfares," and further, "that effective measures should be taken to render the asphalt pavement now existing less dangerous to horses in damp weather."

To obtain exact information on the point the commission in the spring of last year directed observations to be made of the accidents occurring upon asphalt, granite, and wood pavements. These observations (the most extensive, I believe, ever made) were taken by the city police and reported on by me on the 16th December last; to that report it will be now necessary to refer.

The streets selected for observation were: Cheapside and the Poultry, paved with compressed asphalt of the Val de Travers Company; part of King William street and Gracechurch street, paved with the improved wood pavement and the ligno-mineral pavement, and parts of King William street and Cannon street, paved with 3 inch Aberdeen granite. All the streets had a large and varied traffic. The observations were continued for 50 days of 12 hours daily, and represented an aggregate distance traveled by the horses of 478,523 miles.

The observations on asphalt and wood are alone dealt with here. Both pavements were in excellent surface condition; on both the gradients were for the most part good, those of the wood being the worst; both were cleansed every morning and also throughout the day by street orderlies. The asphalt was occasionally washed, and when damp strewed with sand. The wood pavement was four times slightly strewed with fine gravel. The asphalt was not watered to lay the dust; the wood was. The aggregate distance traveled by the horses during the observations was, on the asphalt 203,805 miles, and on the wood 179,151 miles, making together 382,956 miles.

During the 50 days' observations the weather was for the most part dry and cold. There was an absence of that weather which, creating a damp surface, causes asphalt to be in its most slippery state. The weather was also decidedly favorable to wood. On the whole it may be said that the two pavements were under conditions as nearly similar as are likely to be obtained unless a street be specially selected and paved for the purpose of observations.

A short length of the wood was the ligno-mineral pavement, formed of beech, mineralized, the blocks being of small size, with chamfered edges. The accidents upon this pavement were very much greater proportionally than those on the other wood, a circumstance probably due mainly to the description of the wood, and to its chemical treatment. Fir is almost exclusively used in the formation of wood pavements, but the accidents which took place on the ligno-mineral are included in all the averages given of accidents and mileage.

On the average of the 50 days' observations it was shown that a horse might be expected to travel before it fell—

	Miles.
On the asphalt	191
On the wood	330

The accidents were afterwards separated under three heads, namely, those which occurred when the pavements were dry, those which occurred when they were damp, as during or after a slight rain and after the streets had been watered, and those which took place whilst rain was falling, or whilst the surfaces were quite wet, and the following results were shown:

Days when surface of pavement was generally dry:	Miles.
Asphalt	223
Wood	646
Days when surface of pavement was damp in different degrees, including that arising from surface watering:	
Asphalt	125
Wood	193

Days when surface of pavement was wet:	Miles.
Asphalt	192
Wood	432

Thus, under every condition of surface moisture, and including nearly every condition of weather, frost excepted, the wood was less slippery than the asphalt.

For 32 days the accidents were recorded under the respective heads of falls on knees, falls on haunches, and complete falls, with the following results:

TABLE NO. 3.

	Accidents during 32 days' observations.		
	On knees.	On haunches.	Complete.
	Per cent.	*Per cent.*	*Per cent.*
Asphalt	32.04	24.48	43.48
Wood	84.97	3.07	11.96

Accidents which are the least inconvenient to the traffic and the least injurious to horses are falls on knees, the next in order are falls on haunches, complete falls are the worst of all; and the table shows therefore that in this respect wood was superior to asphalt, the largest proportion of falls on it being on knees.

It is by some considered that the only accidents of importance, or that need be referred to when the safety of a pavement is under consideration, are complete falls. Adopting for the time this view, dismissing the other classes of accidents, and making the calculations in reference to complete falls only, the results of the 32 days' observations were that a horse might be expected to travel before it fell down on its side—

	Miles.
On the asphalt	686
On the wood	2,939

Extending the comparison by distributing complete falls only to the miles traveled, under different conditions of surface as regards moisture, the results were:

Days when the surface of pavement was generally dry:	Miles.
Asphalt	1,101
Wood	4,180

	Miles.
Days when surface of pavement was damp in different degrees, including that arising from surface watering:	
Asphalt	335
Wood	1,592
Days when the surface of pavement was wet:	
Asphalt	568
Wood	3,583

Thus, the obervations show conclu sively the wood to be safer than asphalt, and the accidents on it to be of a less objectionable character.

Mastic and compound asphalts are somewhat less slippery to the human foot than compressed asphalts. How far the difference is perceptible to horses, shod as they are, I can not say, but that which causes this superiority in respect of slipperiness leads to their being more speedily worn out under heavy traffic. There are wood pavements more slippery than the improved wood pavement, which is, perhaps, the least slippery of its class; and had it been out of repair, more accidents, proportionately, would have occurred upon it than actually took place, and all wood pavements get out of repair in time. But whatever asphalt or wood (fir being only meant) had been selected for comparison, there is no reason to believe that the relative values of the two materials, as regards safety, wonld have been reversed, and for comparison it was, of course, necessary to take the two which are the best representatives of their classes for the general purposes of street traffic.

Slight rain makes both asphalt and wood more slippery than it is at other times. On asphalt the slipperiness begins almost immediately the rain commences; wood requires more rain before its worst condition ensues. The slipperiness lasts longer upon the wood, on account of its absorbent nature, than it does upon the asphalt when dry weather ensues after the rain.

When asphalt is in its most slippery state the horses at times fall on it very suddenly; on wood their efforts to save themselves are more effectual. Wood also is frequently in that peculiar condition of surface in which horses slip or glide along it without falling. A small quantity of dirt on asphalt makes it very slippery; wood requires a large quantity. These are general statements, subject to modifications, according to the nature of the wood or asphalt, their condition of repair, and cleanliness.

Slipperiness can be temporarily cured on both pavements, on the asphalt by sprinkling it with sand, on the wood by sprinkling it with gravel. The result in both cases is dirt. The difficulty of cleaning wood as compared with asphalt has already been referred to. The sand thrown on asphalt helps to wear it out; the gravethrown on wood tends to preserve it. Watering or washing asphalt to prevent slips periness has been tried, and no doubt for the time cures it, but sloppy streets are a great nuisance, and not likely to be submitted to. Sand must, with present experience, be the remedy, and when applied is certainly effectual. Sanding is the remedy applied at Paris.

When a horse falls upon asphalt, it has difficulty in getting up. On wood it rises more easily. The difficulty in rising from asphalt can, however, be largely remedied by throwing down a little sand, or a horse-cloth, a care which does not often seem to be bestowed by the drivers.

The effect of frost must be referred to. In times of snow there is but little, if any, difference between the safety of asphalt and wood. In times of sharp frost asphalt is usually dry and safe; wood retaining moisture is very slippery. The effects of frost on pavements in the heart of London should not, however, have undue weight in these considerations, two or three winters sometimes passing without snow lying for an entire day in the city streets, or frost rendering the surface of any pavement slippery for more than a few hours at a time. The cure for slipperiness in all cases is sanding or graveling.

As regards speed of travel.—When asphalt is dry and the road unimpeded, vehicles can be driven over it as quickly and as safely as on other pavements, but in streets of much traffic it is not wise to drive quickly because of the difficulty of stopping a horse; on wood it is easier to stop a horse, times of frost excepted.

As to gradient.—A short length of asphalt in the city has a gradient of 1 in 46, another 1 in 57; nearly the whole length has much better gradients. The commission in 1871 determined not to lay asphalt upon a steeper gradient than 1 in 60, and it is a safe gradient at which to draw the line.

The two wood pavements in Bartholomew lane (Carey's, and the improved wood) have gradients of 1 in 34; in King William street there are gradients of from 1 in 30 to 1 in 37, with cross gradients at the same spots of from 1 in 20 to 1 in 38; part of Ludgate Hill has a gradient of 1 in 26, and all these are safe. Wood, therefore, can be laid with safety at a far steeper gradient than asphalt.

Generally, therefore, whether the question of safety be considered in reference to the distance which a horse may travel before it meets with an accident, or the nature of the accidents which occur, the facility with which a horse can recover itself when it falls, the speed at which it is safe to travel, or the gradient at which the material can be laid, wood is superior to asphalt.

DURABILITY AND COST.

Durability is an element in the cost of all pavements, and it is desirable therefore in the first place to see what has hitherto been the life of asphalt and wood in carriage ways.

Asphalt.—Experience in London in the use of asphalt for carriageway pavements dates from May, 1869; at the end of 1870 there were but 3 streets paved with it in the city, the great bulk of the work having been done in the last 3 years. During that time eleven different sorts have been tried, five of which have failed, and there are others in an unsatisfactory condition, some showing unmistakable signs of decay, and the necessity for a not far distant renewal or extensive reparation. Compressed asphalts have hitherto proved themselves the most durable; those which had been the longest down were examined carefully last year, and the loss on them by wear found to be small, and they were generally in good surface condition.

At Paris it has been used longer and more extensively than in any other city, the first street having been laid with it in 1854. In most of the streets so paved the traffic is small, but there are some, such as the Rue de Richelieu and the Rue Neuve St. Augustin, in which it is considerable. I have been unable to ascertain the actual life of the pavements at Paris, for the system adopted is to repair them immediately they need it, and as each repair is so much new material laid, the whole surface is really renewed in the course of years. The same system is and must be adopted in London. Statements given to me by the companies of the extent of repair done to the various pavements since they were laid do not well agree with my own observations, and the payments agreed to be made for maintaining the pavements must be based upon the assumption of considerable renewal of surface being needed. After full consideration of all circumstances, I think that without much repair none of the asphalts would last more than from 4 to 6 years, and that in the course of from 6 to 10 years the entire surface of all will have been renewed.

There not being, however, sufficient experience to determine the durability of asphalt in this city, all that can be done is to take the contracts entered into for maintaining the pavements as giving both the measure of their life and their cost. This mode was taken in the comparison between the cost of asphalt and granite in my report of 1871. The following table gives the agreed costs of asphalt in some leading thoroughfares:

TABLE No. 4.—*Asphalt pavements.—Table showing the agreed cost per annum of certain asphalt carriage-way pavements in the city of London.*

Situation.	Description of asphalt.	Years to be maintained by contractors.	First cost per square yard.	Agreed cost of maintenance per square yard for the contract term.	Total cost of pavements during contract term per square yard.	Average cost per square yard per annum.
			s. *d.*		£ *s.* *d.*	*s.* *d.*
Cheapside and Poultry.	Val de Travers (compressed).	17	18 0	2 years free; 15 years at 1*s.* 6*d.*=£1 2*s.* 6*d.*	2 0 6	2 4½
Gracechurch street	....do	17	17 0	2 years free; 15 years at 1*s.* 0*d.*=15*s.* 0*d.*	1 12 0	1 10½
Finsbury pavement	....do	17	16 0	2 years free; 15 years at 9*d.*=11*s.* 3*d.*	1 7 3	1 7¼
Moorgate street ...	....do	17	16 0	2 years free; 15 years at 9*d.*=11*s.* 3*d.*	1 7 3	1 7¼
Do.....	Limmer (mastic)..	17	16 0	2 years free, 15 years at 9*d.*=11*s.* 3*d.*	1 7 3	1 7¼
Lombard street....	....do	17	16 0	2 years free; 15 years at 9*d.*=11*s.* 3*d.*	1 7 3	1 7¼
Cornhill	....do	17	15 0	2 years free: 15 years at 9*d.*=11*s.* 3*d.*	1 6 3	1 6½
Mincing lane	....do	17	12 0	2 years free; 15 years at 9*d.*=11*s.* 3*d.*	1 3 3	1 4½

Foundations are included in these estimates, but no excavation. The pavements are to be left as good as new at the expiration of the contracts.

Wood.—Counting size of block as constituting a difference, there must have been more than two dozen different kinds of wood pavements tried in the city. They have been laid in streets both of large and small traffic, and subjected to almost every condition which destroys a pavement. The commission has, therefore, experience of its own both in the durability and the cost of wood.

Last year a report was obtained by the commission from New York respecting the wood pavements in that city, from which it appeared that its average duration did not exceed 5 years. The information is not, however, of that precise character which would make it of use for comparison here; and the climatic conditions at New York are so different to those in London that it might be but of little use even if the information were fuller, for climate affects the safety, durability, and other conditions of both asphalt and wood, and as there is large experience in wood pavement in this metropolis I confine myself to that experience.

The table appended shows the duration and cost of wood pavements in six city thoroughfares, all the pavements having been replaced by asphalt except one.

TABLE No. 5.—*Wood pavements—Table showing the actual duration and cost of certain wood pavements in the city of London.*

Situation.	Date when laid new.	Life.	First cost per square yard.	Total cost of repairs per square yard during life.	Average cost per square yard per annum.
		Yrs. *Ms.*	*s.* *d.*	£ *s.* *d.*	*s.* *d.*
Cornhill.....	May, 1855	10 2	12 2	17 4½	2 11
	July, 1865	6 8	11 6	9 9¾	3 0¼
Gracechurch street	Nov., 1853	11 7	12 8	17 1½	2 6¾
	June, 1865	6 0	11 6	6 11	3 0¾
Lombard street	May, 1851	9 4	9 6	6 0	1 7¾
	Sept., 1860	10 7	9 2	1 0 2	2 9
Lothbury	May, 1854	12 3	12 6	1 8 4¾	3 4
	Aug., 1866	6 1	12 6	3 5¾	2 7½
Mincing lane.....	July, 1841	19 1	14 4	13 4	1 5¼
	Aug., 1860	13 0	9 2	1 2 6¾	2 5¼
Bartholomew lane.....	May, 1854	12 3	12 6	17 5¾	2 5¼
	Aug., 1866	5 5	12 6	3 11¼	3 0¼

Foundations are included, but no excavation.

The average life of the pavements in the three streets with the largest traffic was about 9 years, that of the three streets with the least traffic about 11¼ years.

Nearly all before they were removed had been relaid over their entire surface and some new wood introduced from time to time in lieu of that found too defective to relay.

It will be observed that the wood pavements last removed had a shorter life than the previous pavements. There is more than one reason for this, but it should be stated that nearly all would, by relay and the introduction of some new wood, have endured a few years longer. It was, however, thought by the commission expedient to replace them with asphalt, with the exception of that in Bartholomew lane.

The mean of the three streets of largest traffic gives a cost of 2*s.* 7½*d.* per square yard per annum; the mean of the streets of little traffic a cost of 2*s.* 4¼*d.* per square yard per annum. The cost of the wood pavements which have been removed has, therefore, been higher than the cost of asphalt will be under the existing contracts.

In a previous report I have stated that much of the expense of granite pavements in the city is attributable to their being too much patched and not being relaid over their whole surface at sufficiently early periods. (There were reasons given why this is the case.) The same remarks, in a degree, apply to wood, the blocks of which are not so convertible, nor as a refuse material so valuable as old granite. If they were relaid when it was best for the pavement and most economical to do so, their duration would be increased and their cost diminished.

Under present contracts both the wood and asphalt contractors must be permitted to relay and repair the pavements when it will be best to do such work, and for comparison it is therefore better to take the tendered prices for the wood pavements recently laid as the measure of their life and cost, contrasting them with the tendered prices for maintaining the asphalt. The comparison is not expensive, the commission having in some cases accepted tenders involving the maintenance of wood pavements for short terms only.

TABLE NO. 6.—*Wood pavements—Table showing first cost and tendered cost per annum for maintaining certain wood carriageway pavements in the city of London.*

Situation.	Date when laid.	Name of contractor.	Years to be maintained by contractor.	First cost per square yard.	Agreed cost of maintenance per square yard for contract term.	Total cost during contract term, per square yard.	Average cost per square yard per annum.
				s. *d.*		£ *s.* *d.*	*s.* *d.*
King William street.	Feb., 1873	Improved Wood Paving Co.	16	18 0	1 year free; 15 years, at 1*s.*6*d.* = £1 2*s.* 6*d.*	2 0 6	2 6¼
Ludgate Hill.....	Nov., 1873	....do	16	18 0	1 year free; 15 years, at 1*s.*6*d.* = £1 2*s.* 6*d.*	2 0 6	2 6¼
Portions of Great Tower street and Seething Lane.	Sept., 1873	....do	16	16 0	1 year free; 15 years, at 1*s.*3*d.* = 18*s.* 9*d.*	1 14 9	2 2
Bartholomew lane.	Jan., 1872	Carey.....	(*)	12 6	.....	.....	.....
Do	Dec., 1871	Improved Wood Paving Co.	†3	16 0	3 years free.....	16 0	.....
Duke street.....	May, 1873	Mowlem & Co.	††5	15 3	2 years free; 3 years, at 1*s* = 3*s.*	.....	.....
Houndsditch.....	(§)	....do	††7	17 0	2 years free; 5 years, at 9*d.* = 3*s.* 9*d.*	.....	.....
Do	...do	Carey.....	††7	13 6	2 years free; 5 years, at 1*s.* = 5*s.*	.....	.....

* No agreement.

† These pavements will no doubt last some years longer than the contract term of maintenance.

‡ The Ligno-Mineral Paving Company and the Improved Wood Paving Company offered to maintain their pavements, if laid, for terms of 10 years and 14 years, respectively; their tenders were not accepted.

§ Not yet laid.

In the wood pavements the cost of the foundation is included, but not excavation.

The pavements at the end of each financial year are to be in a good sound condition.

The following table is drawn up from tables Nos. 4 and 6:

TABLE NO. 7.—*Table showing the duration and cost of certain asphalt and wood carriageway pavements, according to tenders made by the respective contractors.*

Situation.	Description.	Years to be maintained by contractor.	Average cost per square yard per annum.
			s. *d.*
Asphalt:			
Cheapside and Poultry	Val de Travers (compressed).	17	2 4½
Gracechurch street	....do	17	1 10½
Finsbury pavement	....do	17	1 7¼
Lombard street	Limmer (mastic)	17	1 7¼
Cornhill	....do	17	1 6½
Wood:			
King William street	Improved wood	16	2 6¼
Ludgate Hill	....do	16	2 6¼
Portion of Great Tower street and Seething lane.	....do	16	2 2

Pavements cost more or less according to the width and traffic of the streets; exact comparison is, therefore, unattainable, but from tables Nos. 4, 6, and 7 it appears generally that the improved wood pavement will be dearer than compressed asphalt, and still dearer if contrasted with limmer. There are other asphalt and wood pavements nominally cheaper, but it is expedient to keep to the best of the two classes for comparison.

CONCLUSIONS.

My general conclusions upon the subject matter of the report are:

Firstly, as regards convenience: That asphalt is the smoothest, driest, cleanest, most pleasing to the eye, and most agreeable pavement for general purposes, but wood the most quiet.

Secondly, as regards cleansing: That wood may be kept cleaner than it hitherto has been, but will be more difficult and expensive to cleanse effectually than asphalt; that as both pavements require occasionally strewing either with sand or gravel, there is not much difference between them in that respect.

Thirdly, as regards construction and repair: That asphalt and wood, taking all seasons and weathers into account, can be laid and repaired with about equal facility, but that the smallest, neatest, cleanest, and most durable repairs can be made in asphalt.

Fourthly, as regards safety: That whether considered in reference to the distance which a horse may travel before it meets with an accident, or the nature of the accident, or the facility with which a horse can recover its footing, or the speed at which it is safe to travel, or the gradient at which the material can be laid, wood is superior to asphalt.

Fifthly, as regards durability and cost: That wood pavements, with repairs, have in this city had a life varying from 6 to 19 years, and that with repairs an average life of about 10 years may be obtained; that the durability of the asphalts is not known, but that under the system of maintenance adopted they may last as long as wood; that contrasting the tenders for laying and maintaining for a term of years the two best pavements of their kinds, wood will be the dearest.

To avoid misapprehension it may be well again to state that these remarks apply, in most cases, to asphalt and wood pavements generally, but are more strictly applicable to the compressed asphalt of the Val de Travers Company and to the improved wood pavement. Also that they apply to streets of much traffic and in London, for where the climate and other conditions are widely different, different results, as regards safety and cost, etc., may be expected.

I have the honor to remain, gentlemen, your most obedient servant,

WILLIAM HAYWOOD,
Engineer and Surveyor.

TABLE No. 8.—*Wood pavements.—Table showing the situation, description, area, and date of completion of the wood pavements in the city of London.*

Situation.	Name of pavement.	Length.	Superficial area.	When completed.	Description of pavement.
		Yards.	*Yards.*		
Bartholomew lane.	Carey's wood pavement.	40	468	Jan., 1872	Fine ballast foundation; paving blocks varying in width from 6½ in. to 7½ in., and in length from 13 in. to 15 in., 6 in. deep; ⅜-in. longitudinal and ¾-in. transverse joints, grouted with lime and sand.
Birchin lane	....do	28	77	June, 1866	Do.
Jewry street	....do	42	253	Feb., 1872	Do.
Little George street	....do	24	148	....do	Do.
Bartholomew lane.	Improved wood pavement.	48	392	Dec., 1871	Plank foundation; blocks 3 in. by 9 in., 5 in. deep; ¾-in. transverse joints filled in with pebbles and tar or other bituminous substances.
Great Tower street and Seething lane.	....do	76	448	Aug. 4, 1873	Plank foundation; blocks 3 in. by 9 in., 6 in. deep; ¾-in. transverse joints filled in with pebbles and tar or other bituminous substances.
King William street, from Gracechurch street and Cannon street to Arthur street.	....do	164	3,446	Aug. 13, 1872	Plank foundation; blocks 3½ in. by 10 in., 6 in. deep; ¾-in. transverse joints filled in with pebbles and tar or other bituminous substances.
King William street (south of Arthur street) and Adelaide place.	....do	147	2,620	Jan. 25, 1873	Do.
Ludgate Hill	....do	266	2,639	Nov. 8, 1873	Do.
Gracechurch street.	Ligno-mineral pavement.	27	210	Aug., 1872	Concrete foundation; blocks 3½ in. by 6 in., 4½ in. deep; ends cut obliquely; ¼-in. joints, grouted with Portland cement.
Cannon street	Mowlem's wood pavement.	37	377	Sept. 5, 1873	Concrete foundation; blocks 3 in. by 9 in., 7 in. deep; ⅛-in. joints, grouted with lias lime and washed sand.
Duke street, Smithfield.	....do	134	676	June 7, 1873	Do.
King William street (north of Cannon street).	Stone's patent wood pavement.	26	284	July 15, 1873	Concrete foundation, with grooves in surface 1½ in. by ½ in., 3 in. apart; blocks 4 in. by 6 in., 4 in. deep; the bottoms shaped to fit in grooves; ½-in. transverse joints, filled in with tar composition.

WM. HAYWOOD.

MARCH 17, 1874.

TABLE NO. 9.—*Asphalt pavements.—Table showing the situation, description, area, and date of completion of the asphalt pavements in the city of London.*

Situation.	Name of pavement.	Length.	Superficial area.	When completed.	Description of pavement.
		Yards.	*Yards.*		
Bow Lane, from Cannon street to Cheapside.	Val de Travers asphalt.	164	425	Sept. 22, 1873	Concrete foundation 6 in. thick; compressed asphalt 2 in. thick.
Cheapside and Poultry.	....do	625	7,938	Dec. 9, 1870	Concrete foundation 9 in., asphalt 2¼ in.
Finsbury pavement and Moorgate.	....do	600	3,861	Aug. 18, 1871	Concrete foundation 6 in., asphalt 2 in.
George yard, Lombard street.	....do	69	232	Apr. 1, 1871	Concrete foundation 6 in., mastic asphalt 1½ in.
Gracechurch street.	....do	272	2,659	July 22, 1871	Concrete foundation 9 in., compressed asphalt 2⅜ in.
King William street (west end).	....do	135	1,439	Nov. 12, 1873	Concrete foundation 6 in., compressed asphalt 2 in.
London wall from Moorgate to Old Broad street.	....do	400	3,164	Oct. 18, 1871	Do.
Mansell street	....do	131	734	Oct. 22, 1871	Do.
Mansion House street.	....do	74	3,043	June 21, 1872	Concrete foundation 6 in., compressed asphalt 2 in.
Milk street	....do	60	297	Mar. 22, 1871	Concrete foundation 9 in., compressed asphalt 2 in.
Moorgate street (north end).	....do	99	1,027	Aug. 18, 1871	Do.
Old Bailey	....do	68	402	May 2, 1871	Do.
Old and New Broad streets.	....do	485	3,671	Mar. 25, 1871	Do.
Queen street	....do	108	799	Apr. 27, 1871	Concrete foundation 9 in., compressed asphalt 2⅜ in.
Russia row	....do	33	80	Mar. 22, 1871	Concrete foundation 6 in., compressed asphalt 2 in.
St. Ann's lane	....do	68	452	Oct. 18, 1873	Do.
Threadneedle street (west end).	....do	47	485	June 5, 1869	Concrete foundation 8 in., compressed asphalt 2 in.; on mastic ½ in.
Threadneedle street (east end).	....do	113	438	Dec. 22, 1871	Concrete foundation 9 in., compressed asphalt 2 in.
Throgmorton street.	....do	43	150	Mar. 30, 1871	Concrete foundation 6 in., compressed asphalt 2 in.
Wood street, from London Wall to Gresham street.	....do	300	1,492	Sept. 7, 1871	Do.
Wood street, from Gresham street to Cheapside.	....do	170	671	Sept. 13, 1873	Do.
Castle street, Holborn.	Limmer asphalt ..	163	567	Nov. 7, 1873	Concrete foundation 6 in., mastic asphalt 2 in.
Clement's lane	....do	129	442	Oct. 23, 1873	Do.
Cornhill	....do	331	3,333	Mar. 6, 1872	Concrete foundation 6 in., mastic asphalt 2 in.
Finch lane	....do	87	227	Sept. 23, 1873	Concrete foundation 6 in., mastic asphalt 2 in.
Lombard street	....do	278	1,153	May 18, 1871	Concrete foundation 9 in., mastic asphalt 2 in.
Mincing lane	....do	197	955	Aug. 23, 1873	Concrete foundation 6 in., mastic asphalt 2 in.
Moorgate street (central).	....do	105	1,038	Sept. 6, 1871	Concrete foundation 9 in., mastic asphalt 2 in.
Old Jewry	....do	156	761	Oct. 18, 1873	Concrete foundation 6 in., mastic asphalt 2 in.
Bishopsgate street within.	Barnett's asphalt .	409	4,288	Dec. 21, 1872	Concrete foundation 9 in., mastic asphalt 2¼ in.
Carter lane, from Creed lane to Paul's Chain.	....do	153	757	Sept. 7, 1872	Do.
Fenchurch street ..	....do	463	3,869	June 11, 1873	Do.
Leadenhall street ..	....do	485	4,189	Apr. 11, 1873	Do.
Lothbury	....do	103	2,384	Oct. 10, 1872	Do.
Moorgate street (south end).	....do	92	1,057	Oct. 14, 1871	Do.
Princes street	Société Francaise des Asphaltes.	39	327	July 18, 1872	Concrete foundation 9 in., compressed asphalt 2⅝ in.
Do	Montrotier asphalt.	40	346	Aug. 14, 1872	Concrete foundation 12 in., compressed asphalt 2 in.
Threadneedle street.*	Maest. asphalt ...	61	281	Jan. 26, 1872	Concrete foundation 9 in., asphalt 2 in.

* Removed January 26, 1872, and Val de Travers compressed asphalt laid in its place.

TABLE NO. 9.—*Asphalt pavements.—Table showing the situation, description, area, and date of completion of the asphalt pavements in the city of London*—Continued.

Situation.	Name of pavement.	Length.	Superficial area.	When completed.	Description of pavement.
		Yards.	*Yards.*		
Princes street*	Trinidad asphalt..	29	340	June 19, 1872	Concrete foundation 9 in., asphalt 2 in.
Do.†	Patent British asphalt.	39	371	July 6, 1872	Do.
King William street.‡	Stone's slipless asphalt.	33	358	July 28, 1873	Concrete foundation 6 in. thick, asphalt 2½ in. thick, composed of tar, cement, sand, and lead ore, compressed by machinery.
Do.§	Foothold metallic asphalt.	28	299	Oct. 27, 1873	Concrete foundation 6 in. thick, asphalt 4 in. thick, viz, 3 in. of English upon 1 in. of foreign manufacture, fused together.

* Removed November 16, 1872, and Val de Travers compressed asphalt laid in its place.
† Removed December 22, 1872, and Val de Travers compressed asphalt laid in its place.
‡ Removed September 12, 1873, and Val de Travers compressed asphalt laid in its place.
§ Removed February 21, 1874, and Val de Travers compressed asphalt laid in its place.

The statements as to the composition of some of the factitious asphalts are as given by the patentees or proprietors.

WM. HAYWOOD.

MARCH 17, 1874.

COST OF MAINTAINING LONDON PAVEMENTS.

ENGINEER AND SURVEYOR'S DEPARTMENT,
Sewers Office, Guildhall, January 24, 1882.

To the honorable the COMMISSIONERS OF SEWERS OF THE CITY OF LONDON:

GENTLEMEN: In pursuance of your reference I beg to lay before you a table giving the annual cost of maintaining in good condition certain of the principal asphalt, wood, and granite carriage-way pavements in the city of London.

The following information is given to enable their relative costs to be properly considered:

ASPHALT PAVEMENTS.

Asphalt pavements are as a rule maintained by the contractors, subject to the following conditions:

The contracts are for a term of 17 years.

For the first 2 years the pavements are maintained at the cost of the contractors, and for the remaining 15 at the cost of the commission at contract prices per square yard per annum, measured over the whole surface of the pavements, for which the contractors are bound to keep the pavements in a good state of repair. At the termination of the contracts the pavements are to be left in a good condition to the satisfaction of the engineer, and so that a square yard of the asphalt is not to weigh less than a specified weight.

WOOD PAVEMENTS.

The contracts for maintaining these are also for 17 years, for the first 2 of which they are maintained at the cost of the contractor, and subsequently, as in the case of the asphalt, at the cost of the commission at a tendered price per square yard per annum, measured over the whole surface, the pavements at the expiration of the term to be in good condition and to the satisfaction of the engineer.

There are a few exceptions, however, both in asphalt and wood, to the mode of contracting for maintenance.

GRANITE PAVEMENTS.

The commission has never contracted for maintaining granite pavements upon the same basis as they have those of wood and asphalt, but the necessary work to the granite has been executed when needed, and paid for according to a schedule of prices contracted for. As far as practicable all the work is measured up.

As almost every main thoroughfare in the city has now for years been paved with wood or asphalt, the best thing is to lay before the commission the estimates of the cost of certain main thoroughfares which were made when they were paved with granite, and just before wood and asphalt were introduced.

The mode of maintaining the granite pavements must also be explained.

It was the custom to lay new granite almost exclusively in main thoroughfares, and when a pavement was so worn as to need a general relay, to remove it altogether and lay a new one in its place. The pavements in main thoroughfares were, therefore, nearly always removed long before they were worn out; this was done so that those streets where the traffic was the greatest might have the best pavements, as well as for other reasons.

The old stones were removed to the stone yard, mixed with the general stock, redressed, sorted into sizes, and then laid in secondary or third-class streets.

Thus it most frequently happened that granite paving stones, first laid in a main thoroughfare, passed, when redressed, into a second-class thoroughfare, and ultimately into one of but little traffic; owing to this system, although the cost of the small repairs of a granite pavement made yearly could readily be arrived at, the total cost of the maintenance over long periods could only be estimated.

I have the honor to remain, gentlemen, your most obedient servant,

W. HAYWOOD,
Engineer and Surveyor.

Return showing the annual cost of maintaining the carriage-way pavements in some of the principal thoroughfares of the city of London.

ASPHALT PAVEMENTS.

Name of thoroughfare.	Description of pavement.	Annual cost of maintenance per yard superficial.
		s. *d.*
Bishopsgate street within	Val de Travers asphalt.	1 3
Cheapside and Poultry	....do	1 6
Fenchurch street, between Gracechurch street and Railway place.	....do	1 6
Finsbury pavement and Moorgate	....do	0 9
Gracechurch street	....do	1 0
Gresham street	....do	1 3
King William street, narrow portion	....do	1 3
London wall	....do	0 9
Moorgate street, between Coleman street buildings and London wall.	....do	0 9
Moorgate street, between Lothbury and Telegraph street.	....do	1 0
New Broad street and Old Broad street	....do	0 9
Paternoster row	....do	1 0
Queen street, between Cheapside and Pancras lane	....do	0 9
Queen street, between Pancras lane and Queen Victoria street.	....do	1 3
Threadneedle street	....do	1 3
Queen Victoria street, from Mansion House to Cannon street.	....do	0 6
Aldgate	Limmer asphalt.	0 9
Cornhill	....do	0 9
Lombard street	....do	0 9
Mark lane	....do	1 0
Mincing lane	....do	0 9
Moorgate street, from Telegraph street to Coleman street buildings.	....do	0 9
Newgate street	....do	0 9

Return showing the annual cost of maintaining the carriage-way pavements, etc.—Cont'd.

ASPHALT PAVEMENTS—Continued.

Name of thoroughfare.	Description of pavements.	Annual cost of maintenance per yard superficial.
		s. d.
Fenchurch street (eastern end)	Société Francaise des asphaltes.	0 9
King street, Cheapside	....do	0 9
Princes street (part of)	....do	1 3
Philpot lane	....do	0 6
Milton street	....do	0 6

WOOD PAVEMENTS.

Aldgate High street	Improved wood	1 0
Bishopsgate street without	... do	1 0
Barbican	....do	1 0
Holborn	....do	1 0
Jewin street	....do	0 10
King William street and Adelaide place	....do	1 6
New Bridge street	....do	1 0
St. Paul's churchyard (western end)	....do	1 3
St. Mary Axe	....do	0 9
Walbrook	Mowlem's wood	1 9
Wormwood street	....do	1 0
Fleet street (west end)	Henson's wood	1 0
Leadenhall street (east end)	....do	1 6
Minories	....do	1 6
Fleet street (eastern half)	Asphaltic wood	1 0
Queen street, between Cannon street and Upper Thames street.	....do	0 10
Cannon street	Carey's wood	1
St. Paul's churchyard (south and east sides)	Gabriel's wood	0

GRANITE PAVEMENTS.

Cheapside	Aberdeen granite 3 by 9 inches	0 6¼
Poultry	....do	0 9½
Old Broad street	....do	0 3
Moorgate street	....do	0 3¾
Lombard street	....do	0 3¼

These are the sums actually paid for jobbing, repairs, and maintaining the pavements generally in a good condition until a relay of the entire surface was needed, when, as stated in the report, page 6, the pavements were replaced by new.

In 1871 I estimated the total cost per square yard of granite pavements in these thoroughfares, assuming that the granite had remained in them until thoroughly worn out, and distributing the first cost of the pavements over their duration, was as follows:

Situation.	Average cost per square yard per annum, including first cost and maintenance.
	s. d.
Cheapside	1 7½
Poultry	2 9½
Old Broad street	1 0½
Moorgate street	1 4½
Lombard street	1 0½

W. HAYWOOD,
Engineer and Surveyor.

LIVERPOOL DISTRICT.

REPORT BY CONSUL SHERMAN.

STREETS.

For particulars of the best class of city street pavement I refer to the report published in Consular Reports No. 117. [Inserted herein].

A more common method where the traffic is heavy is as follows: On a bed of ashes or broken stone, rolled and consolidated, is placed a layer of 1 inch to 1½ inches of sand, and on this Welsh granite sets from 8 to 12 inches long by 6 inches deep and 3 inches wide are laid and the joints run with asphalt. Where the traffic is lighter grit-stone sets 8 to 12 inches long, 8 inches deep, and 6 inches wide are used. These are laid as above, but the joints are simply filled with sand or gravel.

STREETS AND SEWERS OF LIVERPOOL.*

STREET PAVEMENTS.

After many years of experiment and the expenditure of vast sums of money in pavements the corporation of Liverpool now points with justifiable pride to its 250 miles of the best paved streets in the world.

The policy adopted by this corporation in the execution of public works in the best possible manner, and generally by their own workmen, has proved successful in every way; and, by a judicious capital expenditure, the cost of maintenance of the roads, sewers, and other public works is reduced to a minimum, and the greatest economy is thereby attained.

The laying of the impervious pavement which was adopted in 1872 for the carriage-ways of the city has been continued up to date without intermission, and is still in progress, resulting in nearly 1,750,000 yards superficial of impervious carriage-way pavements and a saving by the execution of this class of work unprecedented in municipal experience.

The financial result can best be shown by the following: Dealing with the year 1879, under the present city engineer (Mr. Clement Dunscombe, M. A., M. Inst. C. E.), the estimated expenditure for the general repairs to the roads in this city was £28,000 ($136,080), the mileage of adopted roads at that time being 226 miles. Concurrently with the extension of the impervious carriage-way pavements, the expenditure under this head has been reduced year by year till the estimated cost for the current year (1889) is only £8,400 ($40,824), with a street mileage under repair of 254 miles. This reduction has not been effected, as might at first sight be supposed, by an increased rate under this head, due to an augmented capital expenditure requiring the provision of additional interest and sinking fund to redeem the original debt for paving and like works within 23 years (from 1870, when the loan was effected, to 1893, when it will be paid), as the amount raised on paving rate account in the year 1879 was, approximately, £17,000 ($82,620) more than in the year 1889, although the interest and sinking fund on the debt had increased from about £13,000 ($63,180) per annum in the year 1879 to about £47,000 ($228,420) per annum in the year 1889.

Appended hereto are the specifications for paving first, second, and third class streets.

Pavement designated as first class is usually laid down in the main streets of heavy traffic in the central parts of the city.

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* From Consular Reports, No. 117, for June, 1890.

Permission is never given to private companies or persons to cut through the pavement in any street for any purpose. When such work is necessary, the corporation will do it in its own thorough way, and the interested parties must pay the entire cost—a regulation worth noting.

PAVING SPECIFICATIONS.

First-class streets.—Excavate or fill in the ground, as the case may be, to the requisite level, and remove all surplus material. Properly form and trim off the surface and thoroughly consolidate the same, and then lay a foundation of not less than 6 inches of Portland cement concrete, corporation standard. The paving shall consist of granite or syenite sets, 3¼ inches wide by 6¼ inches deep, from North Wales or other approved quarries, laid in regular, straight, and properly bonded courses, with close joints, and to be evenly bedded on a layer of fine gravel half an inch in thickness. After the paving is laid the joints shall be filled with hard, clean, dry shingle; the sets shall then be thoroughly rammed and additional shingle added until the joints are perfectly full. The joints shall then be carefully grouted until completely filled with hot asphalt, composed of coal pitch and creosote oil, and finally the paving is to be covered with half an inch of sharp gravel.

The crossings shall consist of three rows of 16 by 8 inch granite crossing stones, and the remaining space shall be paved on each side of the crossing stones to the full width of the footway, in a similar manner to the carriage way. The crossing stones shall be of granite of a quality to be approved by the engineer, dressed perfectly true, and out of winding on the face; the sides and joints to be perfectly square and accurately dressed throughout their entire depth; the stones to be bedded on cement concrete, the joints to be filled with shingle and grouted with hot asphalt. A triangular groove an inch wide by three-fourths of an inch deep to be run along the upper surface of each stone. No stone to be less than 3 feet in length.

The footways shall be paved with Yorkshire or Lancashire flags of the best quality, not less than 3 inches thick. No flag to measure less than 2 feet in width or to be of less area than 6 feet; to be solid, free from laminations, the upper surface to be true and free from windings or hollows; the joints to be squared the whole thickness. The flags to be laid on a bed of fine gravel, with close, neat joints flushed in mortar, and in uniform courses breaking bond. The joints to be dressed after laying, where necessary.

The channel stones to be of granite or syenite, of a quality to be approved by the engineer, and to be not less than 3 feet in length. The upper surface, if not self-faced and perfectly true, must be accurately worked out of winding, the bed even and parallel to the face, the sides and ends truly square; the stones to be bedded on cement concrete, and the joints to be filled with clean shingle and grouted with hot asphalt.

The curbstones to be granite or syenite, straight or circular as required, 6 inches thick at top, 7 inches thick at 5 inches below, and not less than that thickness for the remainder of the depth; to be not less than 12 inches deep nor less than 3 feet in length; to be carefully dressed on top, 8 inches down the face, and 3 inches down the back; the remainder of each stone to be hammer dressed; the heading joints to be neatly and accurately squared throughout the entire depth.

Second-class streets.—Excavate or fill in the ground, as the case may be, to the requisite level, and remove all surplus material; properly form and trim off the surface; and thoroughly consolidate the same, and then lay a foundation of (*a*) not less than 6 inches of Portland cement concrete, corporation standard, or (*b*) not less than 6 inches of bituminous concrete, consisting of clean and angular broken stone, grouted with hot asphalt composed of coal pitch and creosote oil, covered with chippings, and thoroughly consolidated by rolling with a roller of sufficient weight. The paving shall consist of granite or syenite sets 3 inches wide by 5 inches deep, or of granite or syenite 4 by 4 inch cubes from North Wales or other approved quarries, laid in

regular, straight, and properly bonded courses, with close joints, and to be evenly bedded on a layer of fine gravel half an inch in thickness. After the paving is laid the joints shall be filled with clean, hard, dry shingle; the sets shall then be thoroughly rammed, and additional shingle added until the joints are perfectly full. The joints shall then be carefully grouted until completely filled with hot asphalt composed of coal pitch and creosote oil, and, finally, the paving shall be covered with half an inch of sharp gravel.

The crossings, footways, channels, and curbs shall be the same as specified for first-class streets.

Third-class streets.—Excavate or fill in the ground, as the case may be, to the requisite level, and remove all surplus material; properly form and trim off the surface and thoroughly consolidate the same, and then lay a foundation of hand-pitched rock 6 inches in depth, set on edge in the manner of a rough pavement. Over this a coating of gravel is to be laid of sufficient thickness to fill in the interstices and to form a smooth surface to the foundation, which must be thoroughly consolidated by rolling with a steam roller before the paving is laid. The paving shall consist of 4 by 4 inch granite or syenite cubes from North Wales or other approved quarries, laid in regular, straight, and properly bonded courses, with close joints, and to be evenly bedded on a layer of fine gravel half an inch in thickness. After the paving is laid the joints shall be filled with clean, hard, dry shingle; the sets shall then be thoroughly rammed and additional shingle added until the joints are perfectly full. The joints shall then be carefully grouted, until completely filled up, with hot asphalt composed of coal pitch and creosote oil, and, finally, the paving shall be covered with half an inch of sharp gravel.

The crossings, footways, channels, and curbs shall be the same as specified for first-class streets.

Street Railways.

All the street railway tracks (tramways) are laid and owned and kept in condition by the corporation, and the company leasing them for traffic pays an annual rental of 10 per cent. on their cost.

The superb manner in which these rails are placed is fully shown in an illustrated report of the city engineer, from which I quote:

"The Liverpool city lines as now laid * * * are conclusive proof that when tramways are well designed and properly constructed they do not form the slightest impediment even to the narrowest wheeled vehicles."

Sewers.

During the past 17 years the corporation has expended for sewerage works approximately £350,000 ($1,703,000), and this outlay has been thoroughly reproductive from a sanitary point of view in a lessened mortality rate. Interesting details on this subject are given in the illustrated report of the city engineer which is inclosed herewith.

SEWERS OF LIVERPOOL.

[Extracts from the annual report of the city engineer, Mr. Dunscombe.]

Ventilation of sewers.

Prior to 1871 there we re noventilators fixed upon the main sewers in the city. At that date 1,046 Archimedean screw ventilators, 6 inches in diameter, were connected with the branch sewers from courts, the 6-inch pipe being attached to the side of one of the court houses wherever permission could be obtained. Of this number there are at the present time 976 remaining, which includes a few shaft ventilators added since 1871, mainly in confined situations where open grid ventilation was found to be

objectionable, the demolition of insanitary court houses and of property for railway and other improvements having reduced the number that were originally fixed.*

The cost of these ventilators, including fixing, is stated to be £10 each, and the annual cost of maintenance about 5*s.* each.

Ventilating grids or ventilating manhole covers, as the case may be, the clear opening in each being not less than 63 square inches, have been fixed along the main sewers at a distance apart of 80 yards approximately.

Drawing No. 1, figure 1, shows the arrangement adopted where the ventilating grating is fixed over a chamber constructed at the side of a manhole.

Drawing No. 1, figure 2, shows a manhole cover and ventilator combined.

Where the distance between the manholes is more than the specified distance apart of 80 yards, ventilating grids, as shown in drawing No. 1, Fig. 4, have been fixed on special shafts over the sewer, so that this uniform distance is maintained throughout.

Prior to 1876 detail records do not seem to have been kept in the engineer's department of the rate of progress of this work, but it appears that up to that year 28 miles of main sewers had been ventilated.

With the exception of those sewers into which hot water is discharged or steam injected, and which are few in number, the ventilation of the whole of the Liverpool main sewers was completed in 1882, embracing the following mileage, viz:

	Miles
Up to 1876	28
1876	16
1877	18
1878	12
1879	41
1880	35
1881	25
1882	2
Length of sewers ventilated to year 1882	177
New sewers constructed and old sewers reconstructed from 1876 to 1885 inclusive.	72
Total mileage of brick and pipe sewers ventilated to year 1885	249

All new sewers are now ventilated in a similar manner, as their construction proceeds.

The total cost of ventilation has been £12,000, or 7*d.* per yard run of sewer.

Reconstruction and alteration of gullies.

The records of the progress of this work up to 1880 appear to be incomplete. Since that year all defective gullies have been altered, improved, or reconstructed practically in accordance with drawing No. 1, Fig. 3, and all new gullies have been built in accordance with this drawing.

This form of gully combines the essentials requisite to reduce to a minimum the quantity of detritus entering the sewers.

Up to date 5,219 gullies have been constructed or reconstructed.

Cleansing of sewers.

No systematic cleansing of the sewers appears to have obtained prior to 1871, but from that year systematic cleansing of the main sewers in the lower districts of the city and tide-locked sewers has been carried out, in addition to the cleansing which takes place previous to the execution of repairs.

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* As regards the Archimedean screw ventilators, Drs. Parkes and Sanderson state in their report as their opinion that, notwithstanding the mechanical efficiency of the Archimedean screw ventilators, they exercise no practical influence in preventing the escape of sewer air into the streets and houses.

The necessity for cleansing the sewers which have been repaired and the gullies emptying into same rebuilt has been in a great measure obviated owing to—

(1) The improved construction of the gullies, by which less detritus enters the sewers, the extension of impervious pavements of slow-wearing material, and the reduction in the area of macadamized roads.

(2) The generally self-cleansing condition of the sewers as repaired, and their systematic flushing.

The cost of this work for the parish is £1,302 per annum, and for the out townships £1,736 per annum.

Repairs on rates account.

Preparatory to executing any repairs in a sewer it is thoroughly cleansed, and then inspected to ascertain what repairs are necessary, in order to put it into perfect condition and make it, in the future, as far as possible self-cleansing.

The repairs executed to the sewers are: (1) Repairs dependent upon the defective junction of branch sewers with main sewers, either in plan or section; (2) repairs required consequent upon the natural decay or wearing away of the materials forming the sewer.

(1) *Defective junction of branch sewers with main sewers.*—Where a branch sewer meets a main brick sewer at the same invert level, this has been altered, wherever the gradient would admit of it, by raising the invert level so that it outlets into the main at its proper relative level and running the gradient out to meet the ordinary gradient of the branch sewer—the work being executed in Portland cement concrete. Where a branch meets the main sewer at right angles, the junction is altered to a curve of moderate radius.

(2) *Sewers decayed and worn.*—In the case of repairs consequent upon the natural decay of wearing away of the materials forming the sewer, the mode of procedure is as follows:

(*a*) *Pointing.*—After cleansing and examination the class of repairs required is decided upon. In some cases the raking out of the joints of the brickwork, washing it, and repointing in Portland cement mortar mixed in the proportions of 1 of cement to 1 of sand will meet the case.

(*b*) *Pointing and reinverting.*—In some instances the invert of the sewer is found to be worn away, or constructed so unevenly as to assist the formation of deposit. In this case, in addition to the pointing already described, the invert of the sewer is improved in cross-section and gradient, the mode of procedure being as follows:

The sewer being cleansed, the joints are raked out, as before stated, and the sewer is reinverted with Portland cement concrete averaging 2 parts of river gravel to 1 part of cement, the surface being finished in the proportion of 1 part of cement to 1 part of gravel.

This mode of treatment constitutes the work executed in the majority of the old sewers dealt with in the parish of Liverpool.

Owing to the large dimensions of the main sewers, the whole of the operations in connection with their repair are conducted without in any way disturbing the pavements; the work is executed between manhole and manhole, the sewage in the sewer operated upon being dammed back at the point under repair and provision made for the discharge of the sewage through pipes or open troughs suspended from the portion of sewer undergoing repairs. After the lapse of about 4 days from completion of the respective repairs the sewage is again allowed to flow through the sewer.

Reconstruction on capital account.

(1) *Defective construction or workmanship.*—(*a*) These consist generally of sewers driven in headings prepared for 9-inch work. The sewers have only been executed in 4½-inch work, except at the termination of each center length, the space between

the brick arch and the rock roof, including the space for the 4½-inch ring of brickwork omitted, not being filled in with any material.

(*b*) Sewers for which the headings have been taken out considerably larger than actually required for the size of the sewer and thickness of brickwork, and this extra space in the heading above the 9-inch brickwork has not been filled in.

These sewers are practically the same as shown in drawing No. 4, Figs. 1 and 2, with the exception that the thickness of the brickwork of the arch is 9 inches throughout.

In heavy storms they will probably run full and under considerable pressure, and when these defects exist the crown of the sewer is lifted and the arch fractured. Their reconstruction consists in re-arching and filling in the headings solid. The inverts of many of these sewers are, in addition, found to have worn away considerably, and advantage is taken, when executing the work of re-arching, to reline the invert with radiating blue bricks.

Examples of defects *a* and *b* have occurred as follows, viz: Bankhall relieving sewer, from Stanley road to the canal, is a type of the class *a;* in 1883 the arch of this sewer was reconstructed and the invert lined with blue bricks. Sandhills lane outfall sewer, which is 6 feet by 4 feet, is an example of *b* as described; the portion passing under Great Homer street and Smith street has already been completed, and the length passing under Lambeth road and Sandhills lane has been recently commenced.

(2) *Sewers driven in the sandstone rock.*—The next description of sewers which require reconstruction are those which are found on examination to be simply headings driven through the sandstone rock neither in line nor level. New brick sewers were constructed within these headings in proper direction and level, the remaining portion of the heading being carefully filled in. Types of sewers which have been recently dealt with were situated in Catharine street, Canning street, Percy street, Huskisson street, etc.

(3) *Brick sewers past repair.*—Sewers past repair, owing to natural decay of the materials of which they are formed, and therefore require to be constructed anew. When these sewers are reconstructed advantage is taken, wherever possible, to improve their level, gradient, and cross-section. Types of sewers recently dealt with were Waterloo road, Bath street, Grundy street, Errington street, Haigh street, and Dingle outfall sewers.

(4) *Pipe-passage sewers.*—These sewers, when found to be defective, are reconstructed. Generally, those dealt with have been laid for many years, and the defects in them consist principally in the quality of the pipes and mode of jointing. In many cases, owing to the ground being filled-in ground, its subsequent settlement has caused inequalities in the line of sewer and breakages of the pipes, resulting in stoppages and rendering anything short of reconstruction unsatisfactory. Such sewers have generally been found in the older residential parts of the city.

Since 1879, 14 miles of main sewers, mostly of large capacity, have been reconstructed at a cost of £51,739.

New brick sewers.

All new brick sewers are generally constructed in accordance with drawing No. 4, Fig. 4, with bricks molded to the respective radii, and in certain cases the invert is lined with best radiating blue bricks.

Progress of repairs.

The following table shows the areas dealt with from 1873 to 1885, inclusive:

Years.	Acres.	Miles of sewers repaired.
1873–'75	206	13
1876–'79	781	28
1880–'85	657	37¼

The results from these repairs have been most satisfactory, both on sanitary and economical grounds.

(1) Freedom from deposits in the sewers and a quicker discharge of the sewage to the respective outfalls, and consequent lessened impurity of the sewer air, which can thus be more readily rendered perfectly innocuous by dilution with fresh air through the open gratings fixed over the sewers. When the main causes of the impurity of the sewer air, viz, deposits in the sewers, are removed, open grid ventilation, as adopted in Liverpool, by which means the sewer air is diluted, is an effective system which can be carried out at a moderate cost.

(2) On economical grounds the repairs have been satisfactory, by diminished cleansing of the sewers repaired, and preventing the necessity of reconstructing the sewers so dealt with at some future time at considerable cost.

When large volumes of hot water discharge into a sewer and can not be prevented, and where wastes from chemical or other works empty into it, special means of ventilation other than by open grids is necessary, and in certain cases it may be preferable to construct a special drain for these discharges.

Permanency of repairs.

In order to ascertain the permanency of repairs executed as already described, the engineer has caused a careful examination to be made of eighty of the sewers, selected at random, which were repaired between 1873 and the present time.

The selected sewers in which repairs have been executed during the years 1873'–75, and which may be taken as representative ones for those years, have evidently had little done to them, the principal work being cementing the invert and rough pointing. Some of these sewers may probably require to be again repaired within a period of from 10 to 15 years. The amount expended in these sewers has evidently been small, and consequently the repairs in them can not be expected to last so long as those done at subsequent periods. The expenditure, however, has been more than recouped by the saving effected in cleansing them and their increased efficiency. From 1876 to 1878 the repairs executed have been of a far more substantial character, and may reasonably be expected to last many years. From 1879 to date, the repairs have been executed strictly in accordance with the methods previously described, and the quality of the work can not well be improved; the sewers as now repaired are practically equal to new ones.

The superiority of the work in recent years is readily accounted for—all the men now engaged upon the work are well trained in the various classes of repairs requisite. Skilled bricklayers are employed to execute the work, which, in addition, is carefully supervised. Portland cement concrete or mortar only is used.

House-drainage regulations.

In 1882 the engineer prepared draft by-laws with respect to the drainage of buildings. They were duly approved by the health committee, and were subsequently confirmed by the local government board in November, 1883. From this date all new buildings erected in the city have been drained in conformity with these regulations, which are found to work satisfactorily.

Except in the center of the parish of Liverpool, the houses are drained on what may be termed the "back drainage" system, the drains discharging into the passing sewer at the rear of the premises, avoiding the necessity of any of them passing under the buildings, and admitting of the houses being drained on the best sanitary principles, and affording easy means for their periodical inspection.

The estimated cost of executing the drainage of a cottage house in Liverpool under these regulations, inclusive of closet-pan and siphon, siphon-trap and waste from sink, also bath waste, is, in the case of a cottage house with an external water-closet, £3 10*s*., and, with an internal water-closet in addition, £4 5*s*.

With such additional appliances and fittings as may be requisite the system of drainage adopted for the cottage house is equally applicable in degree to the largest houses in the city. The highest sanitary standard of house drainage is extremely simple in arrangement and need not necessarily be expensive, but, on the other hand, can in ordinary cases be carried out at such a moderate expenditure as should encourage owners of house property to reconstruct the drainage of same where it is not in accordance with the most modern practice as defined by these drainage regulations.

Flushing of sewers and private drains.

All main sewers that are not self-cleansing are periodically flushed by large movable tanks placed over a manhole on the sewer. These tanks contain 1,800 gallons of water, and discharge their contents into the sewer through a valve at the bottom of the tank in 28 seconds. The cost of this work is about £1,200 per annum. All passage sewers are flushed four times annually by special gangs, either from chambers at the head of each sewer or by hose connected with hydrants fixed in convenient positions, and, in addition, they are indirectly flushed twice annually by the private drains flushing gang. The cost of this work is about £1,100 per annum.

In December, 1880, on the recommendation of the engineer, the health committee resolved to flush all private drains twice annually, free of cost to the occupiers, and oftener on payment of a small fee, regulated according to the ratable value of the premises, and this work has since been regularly carried out. It is so arranged that a flushing gang visits each house in the city once every six months.

The staff for this work comprises one flushing inspector, one foreman, and sixteen gangs of three men each.

The drains, water-closets, and soil-pipes within the curtilage of all premises are flushed by hose attached to hydrants fixed at convenient distances in the passages or adjacent streets.

The occupiers of the houses willingly coöperate and afford every facility for executing this important sanitary work, and although 107,000 houses, exclusive of warehouses, stores, offices, etc., are visited twice annually, few complaints reach the department relative to the manner in which any of the operations are conducted.

The cost of this work is £5,000 per annum, or under 6*d*. per house for each flushing. In all cases the water is supplied free of cost by the water committee of the corporation.

Inspection of main sewers by special gangs.

This work has only been carried out systematically since October, 1885. Previous to that date, however, all sewers were examined wherever connections were made with them for the drainage of property, also prior to cleansing or executing repairs or other work, and reports made as to their condition either by the sewer inspectors or workmen engaged, so that practically the inspectors and workmen were conversant generally with the condition of the sewers. The periodical inspection of all the sewers is, however, preferable.

So far as the inspection has gone, which in the future will be a continuous one, it has been ascertained that the remaining sewers in Liverpool will in every case require to be dealt with as already described.

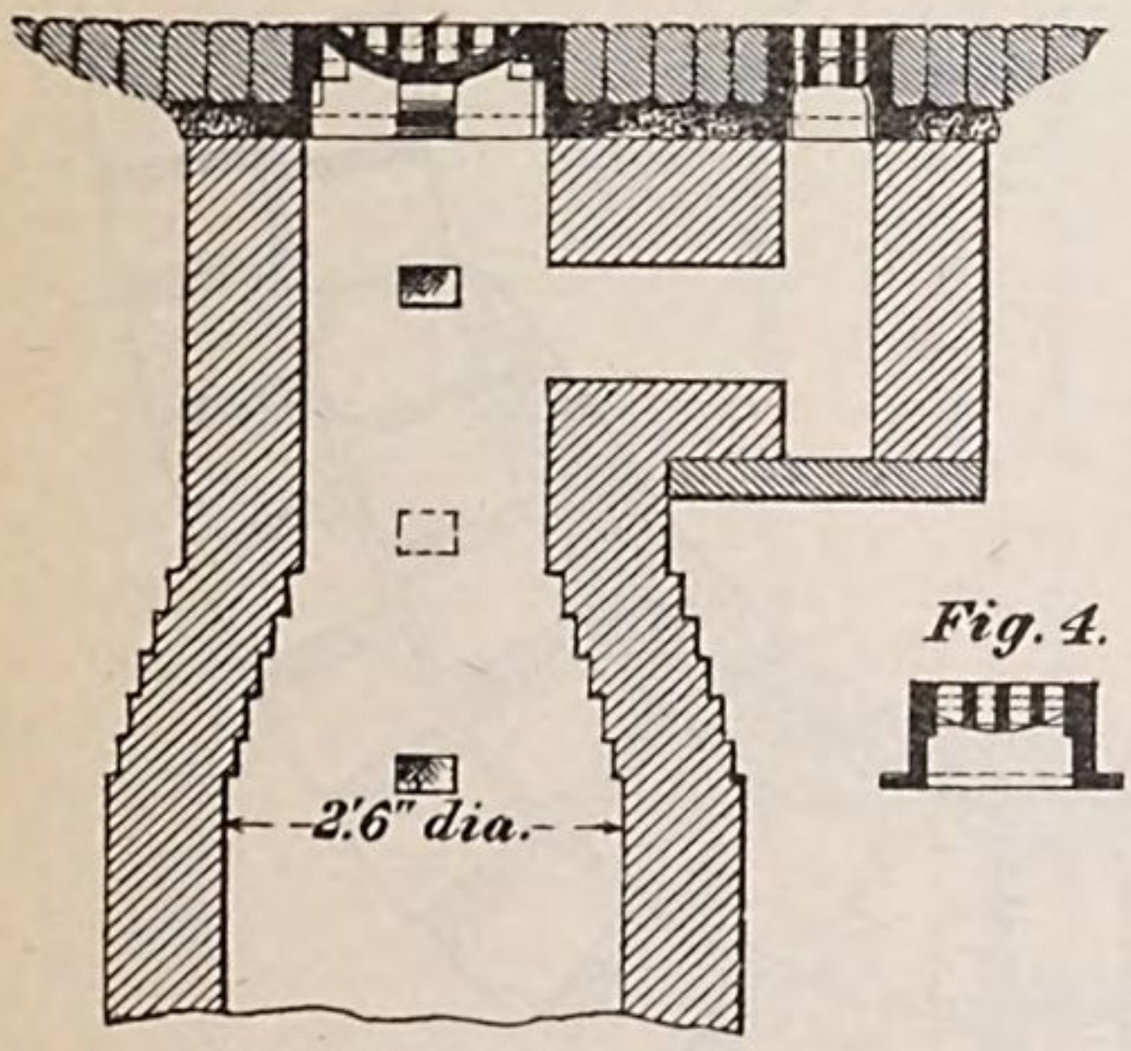
Expenditure.

From the table annexed it will be seen that the majority of the repairs up to the present date have been carried out within the parish. The engineer estimates that the corporation has expended, from 1873 to date, the following sums in repairs and cleansing consequent on repairs :

Years.	Parish of Liverpool.	Township of Kirkdale.	Township of Everton.	Township of West Derby.	Township of Toxteth Park.
1873-'79	£19,520	.....	£600	£200	£1,270
1880-'85	59,486	£1,955	3,795	4,269	3,650
Total	79,006	1,955	4,395	4,469	4,920

During this period 78¼ miles of main sewers have been repaired at a total cost of £94,745. Of this mileage 62¼ miles are in the parish.

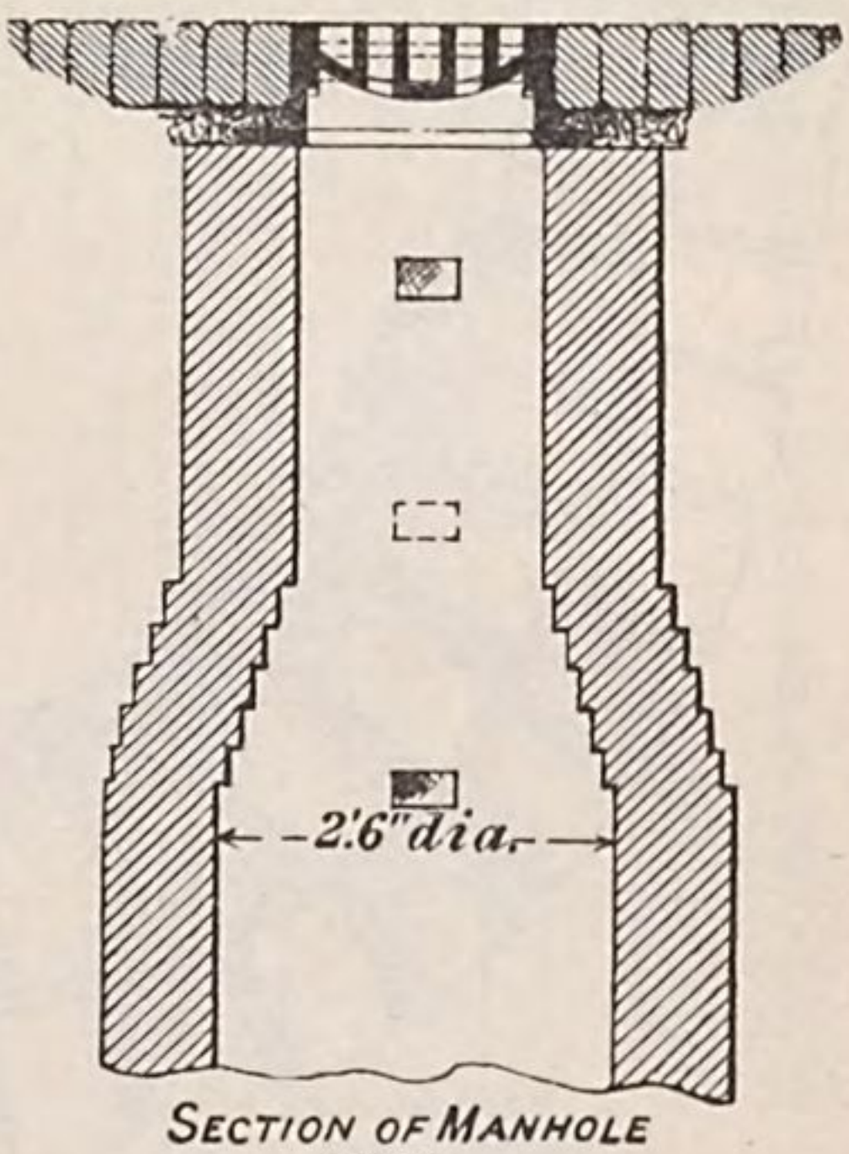
Fig. 1.



SECTION OF MANHOLE SHOWING SOLID COVER AND VENTILATING CHAMBER.

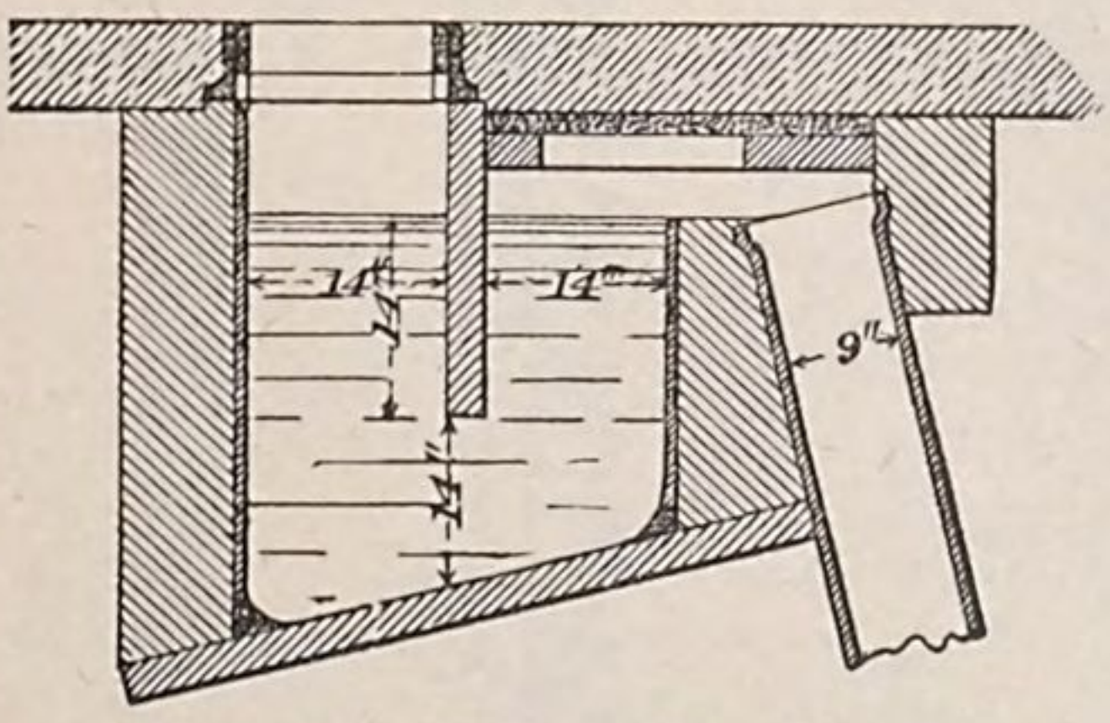
Fig. 4.

Fig. 2.



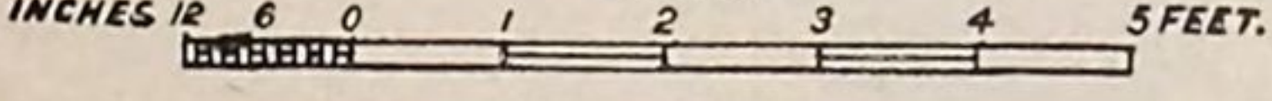
SECTION OF MANHOLE WITH VENTILATING COVER.

Fig. 3.

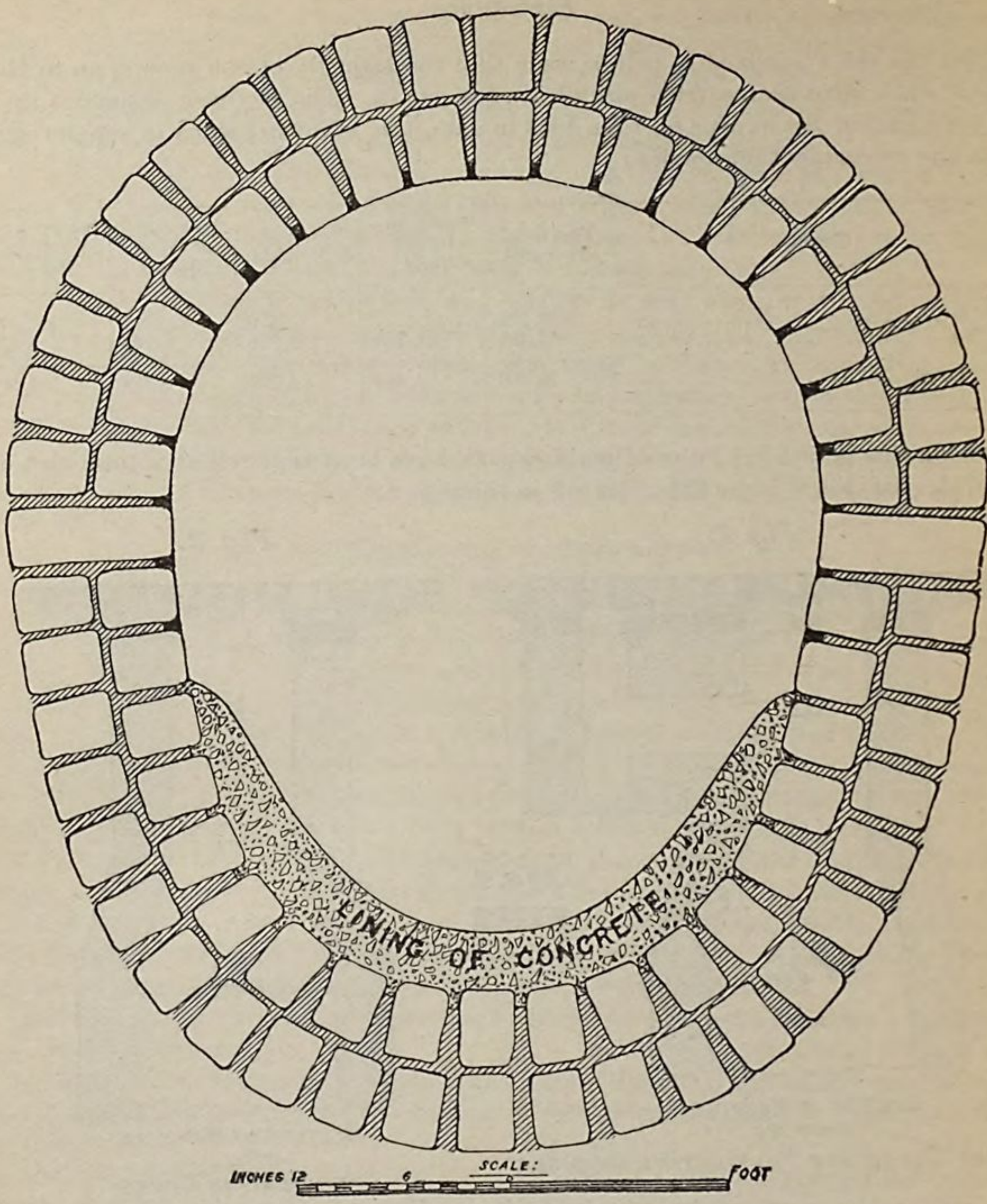


SECTION OF WATER-TRAPPED GULLY.

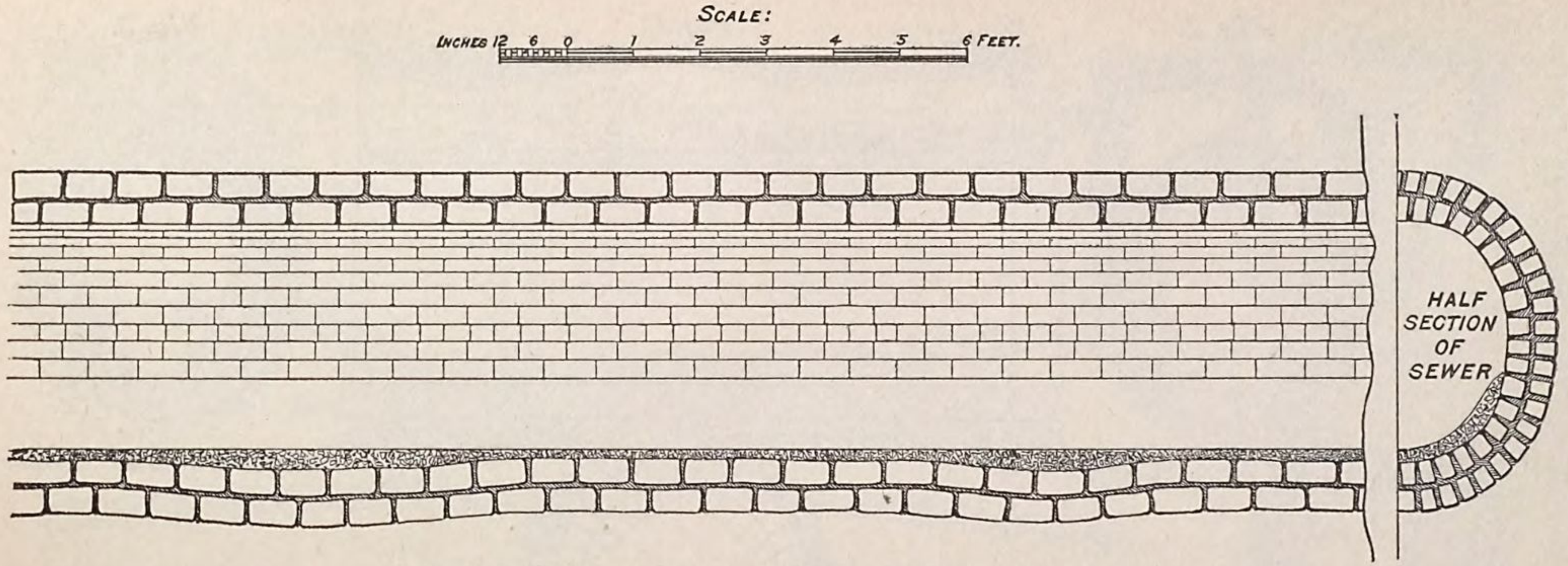
Scale.



DRAWING NO. 1.

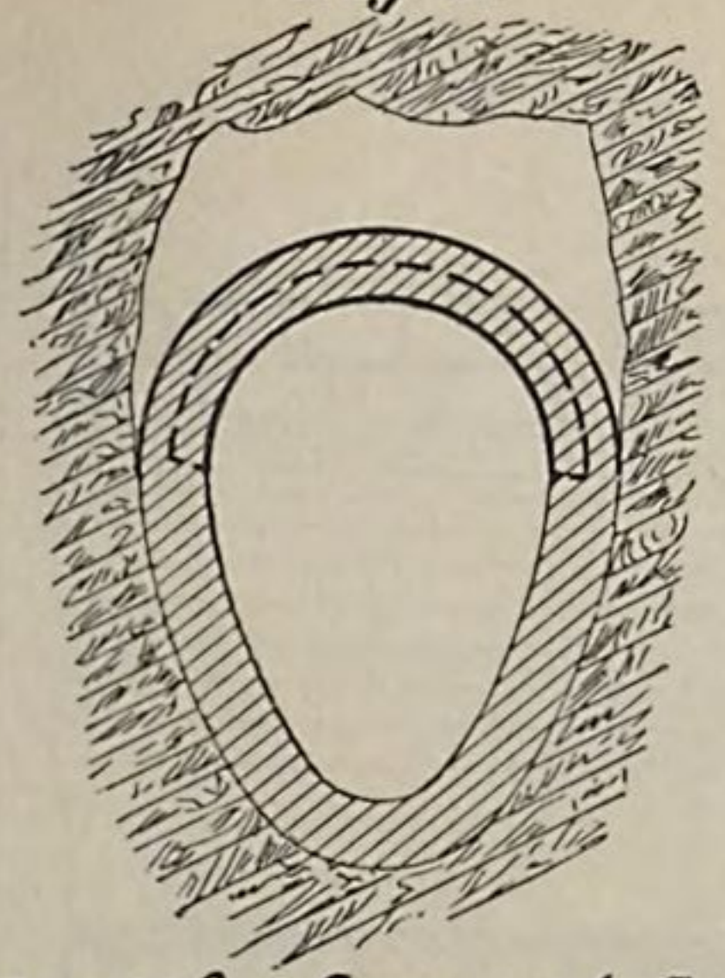


DRAWING NO. 2.—Cross-section showing Portland cement concrete invert.



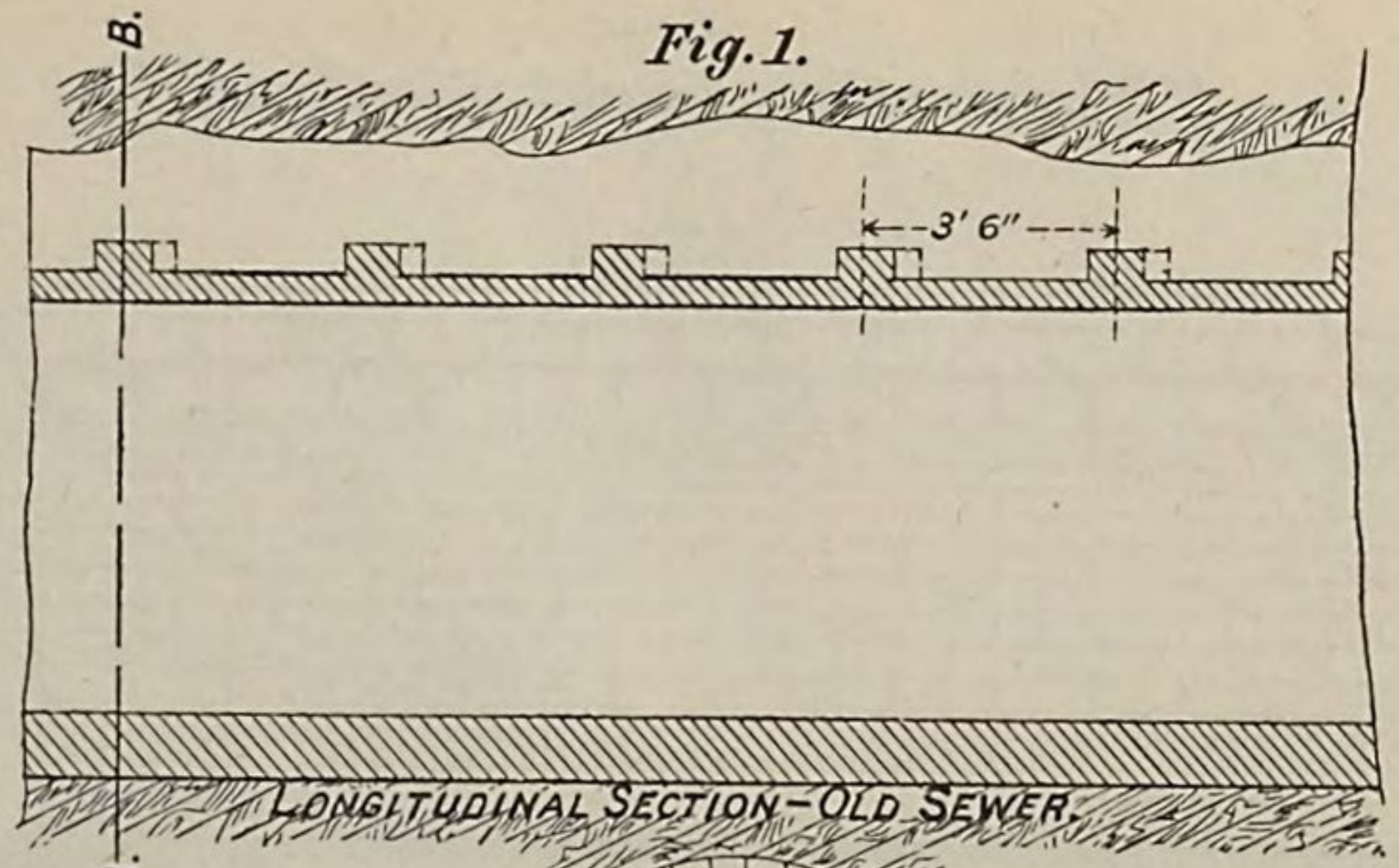
DRAWING NO. 3.—Longitudinal section showing Portland cement concrete invert.

Fig. 2.



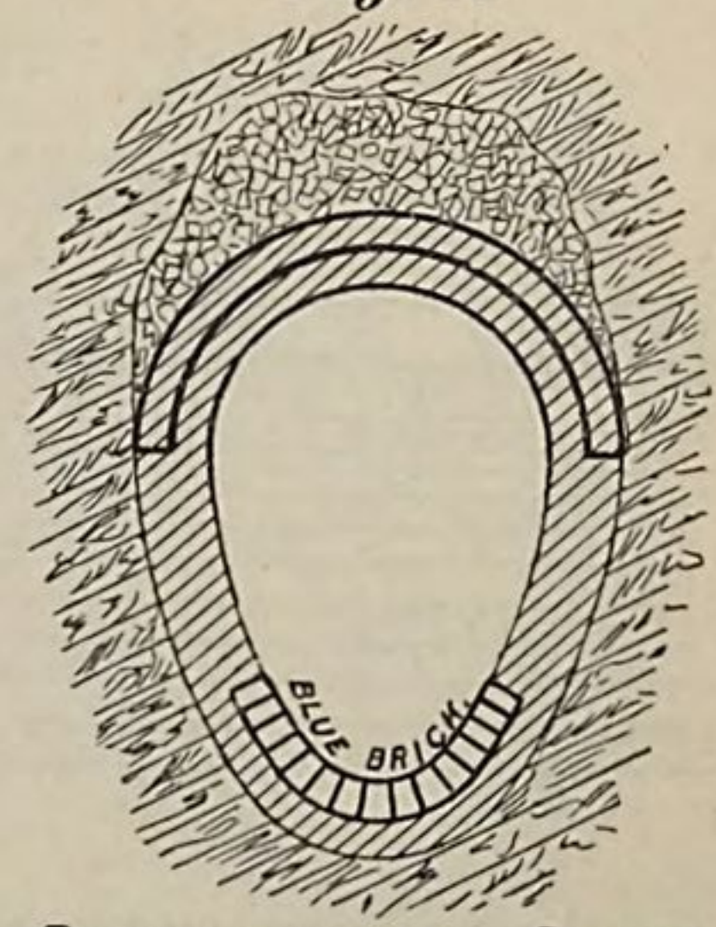
SECTION OF OLD SEWER AT A. B.

Fig. 1.



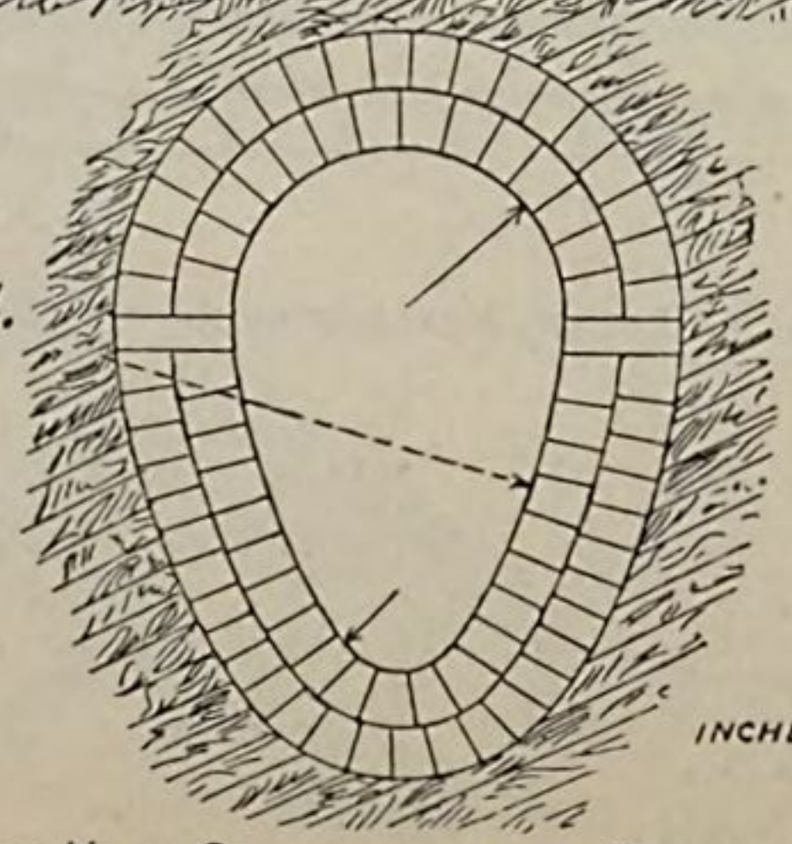
LONGITUDINAL SECTION—OLD SEWER.

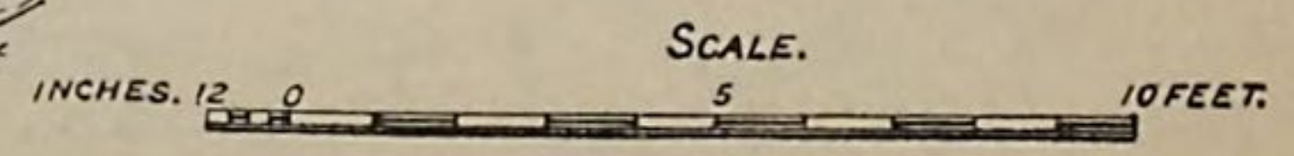
Fig. 3.



RECONSTRUCTED SEWER.

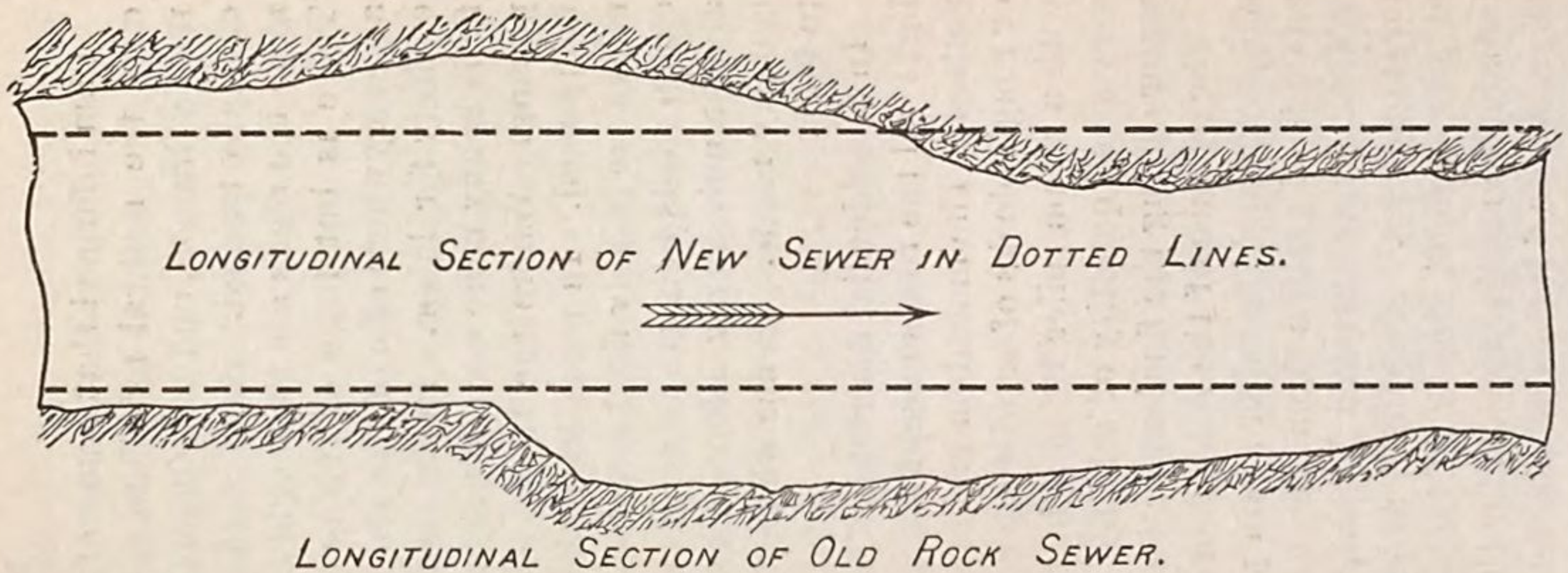
Fig. 4.



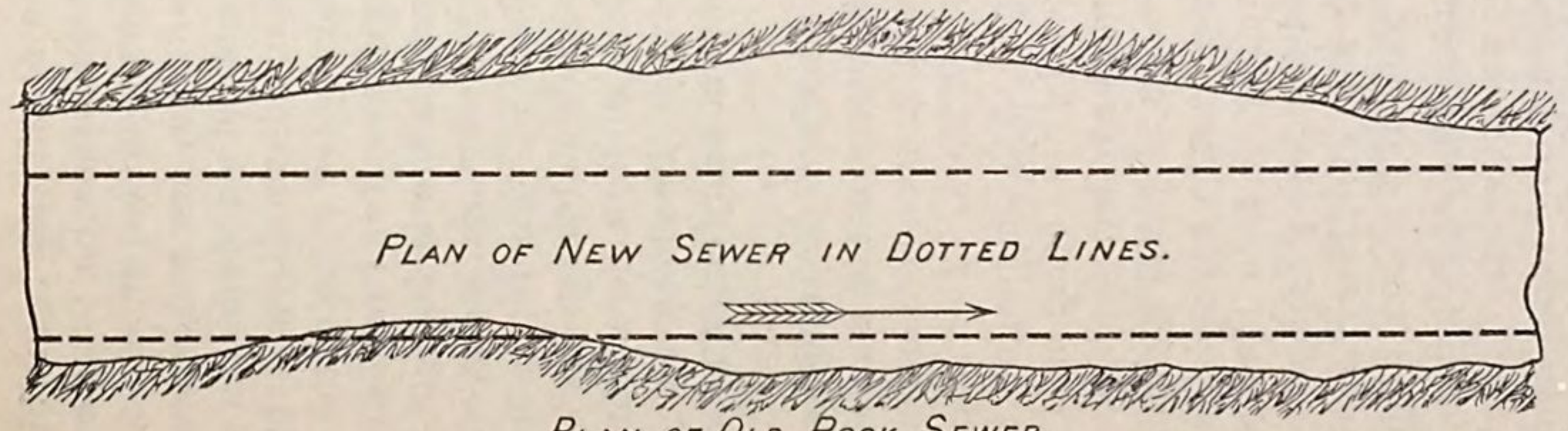


SECTION OF NEW SEWER AS NOW CONSTRUCTED.

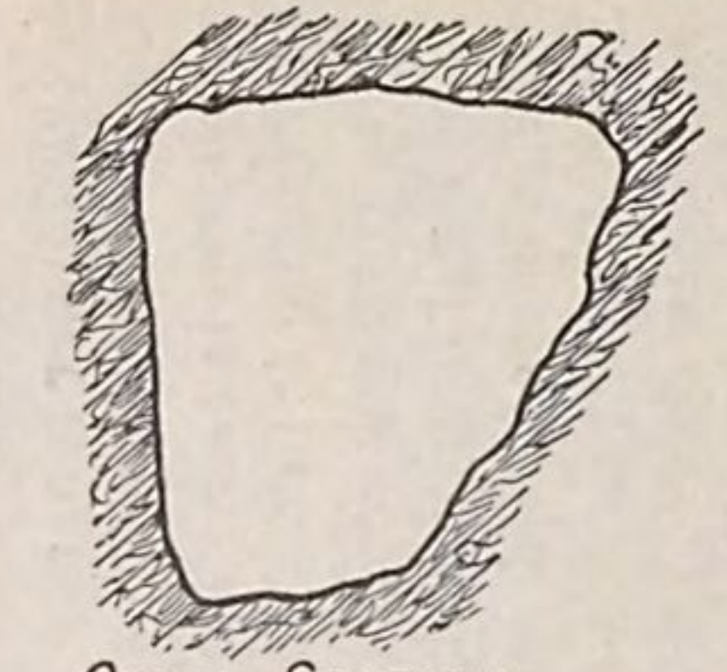
DRAWING NO. 4.



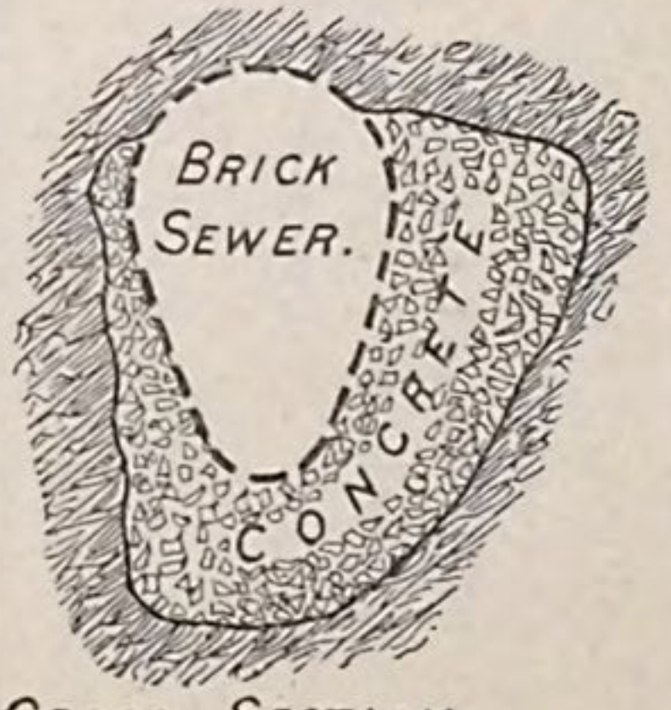
LONGITUDINAL SECTION OF OLD ROCK SEWER.



PLAN OF OLD ROCK SEWER.



CROSS SECTION
OLD ROCK SEWER.



CROSS SECTION
SHOWING METHOD OF DEALING
WITH OLD ROCK SEWERS.

DRAWING NO. 5.—Plan showing method of dealing with old rock headings which have been used as sewers.

HIGHWAYS.

I am informed that some of the country roads in this vicinity have only the natural foundation, which means no foundation at all, are poorly drained, and have been much neglected, but are now being more carefully treated. Such roads, however, are rarely seen, and in the main the roads are thoroughly made and maintained in good condition. There is but little of the common "dirt road," and this is made here as everywhere else of the material nearest at hand, the expense being entirely for labor. In the vicinity of works and mines where the traffic is heavy more care is taken, and granite is brought by rail for repairing. Where the traffic is lighter the local stone, whatever it may be, is used. In some localities slag and other refuse from works and mines are largely used for country roads and for streets in towns. Such cheap roads being the exception, it is difficult here, where macadam is almost universally adopted, to draw the line between city streets and country roads. Hence what follows in many cases necessarily relates to both.

In a residential district in Cheshire where the traffic is comparatively light all the roads except along the route of the tramway are macadamized. The macadam is 6 inches thick upon a foundation of pitching or rough blocks of sandstone 8 inches thick. The macadam is rolled with a steam roller 10 tons in weight until thoroughly consolidated, a very small quantity of selected road detritus being used with plenty of water during the final operations on the roller.

The surface of the road then receives a liberal sprinkling of granite chippings and the roller again passes over it several times. The macadam is of granite from Penmaenmawr, or from Port Nant, in North Wales, about 100 miles distant, and the rock pitching is obtained from local quarries. A channel at each side of the carriageway is formed of grit channel stones 10 inches wide by 5 inches deep, laid upon a foundation similar to that for the macadam, except in main thoroughfares, where 6 inches of concrete is used instead. The channels are in all cases backed up by the curb, which is laid at an average height of 4 inches above the channel. The cost of the macadam delivered on to the works averages about 9*s.* ($2.19) per ton, and the pitching about 3*s.* ($0.73) per ton, and the channel stones about 2*s.* (48 cents) per yard. The cost of constructing such a road with only the ordinary amount of excavation is about 5*s.* ($1 21) per square yard, and the average cost of maintaining it in this district is at the rate of about 6*d.* (12 cents) per square yard per annum (including scavenging and watering).

The local board of Great Crosby, near Liverpool, generally specifies for 10 inches of hard rock to be properly set on edge, the stones not to exceed 4 inches in breadth, and the interstices closely packed by hand. The average cost of laying the foundation is 40 cents per square yard. The macadam, cubically hand broken to pass through a 2-inch ring, costs $2.30 per ton delivered, and is laid on in two coats properly watered

and rolled with a steam roller, and finished off to a smooth surface by adding fine chippings. This class of roadway costs about 65 cents per square yard, exclusive of foundation. For roads of tar macadam the same quantity of macadam is used and mixed with due proportions of pitch and tar, forming one homogeneous mass. This is rolled with the steam roller, and finished off with fine chippings, no water being used. Average cost 90 cents per square yard, exclusive of foundation. The tar macadam is found to be well adapted to a sandy district, owing to the liability of drift sand to disintegrate an ordinary macadamized roadway. It makes a capital roadway, causes a minimum of dust, and is most rapidly scavenged, but it is very slippery in frosty weather.

In Carnarvonshire, Wales, the best roads have a hand-set pavement for a foundation (the ground first of all being well drained), covered with about 6 inches of metaling broken to a 2-inch gauge, costing $1.50 per ton at the quarry and about $2.25 per ton on the road. The cost of constructing such a road is about $1 per square yard.

In the Wavertree district, near Liverpool, macadamized roads are preferred and the first cost is estimated at about $1.50 per superficial yard, exclusive of sewering. (See specification herewith.)

WAVERTREE DISTRICT.

Specification of works required to be performed and materials to be used in the construction of roads situate in the local government district of Wavertree.

In this specification the following words shall have the meanings hereinafter set forth, namely:

"The contractor" shall mean and include the person or persons agreeing to execute the works described in this specification, and shall also mean and include the executors and administrators of such person or persons and the words in singular number shall include the plural.

"The local board" shall mean the local board of health for the local government district of Wavertree.

"The surveyor" shall mean the surveyor for the time being, of the local board, or other person or persons for the time being, appointed by the said local board, to superintend the execution of the said works.

"The works" shall mean the several works, matters, and things, comprised or referred to in and by this specification, or intended so to be, and by the contractor to be executed and performed.

Excavation.—Excavate or fill in the carriage way to a depth of 16 inches below the finished cross-sectional line of street, which will be calculated at the rate of five-eighth inches to every foot of half the width of the carriage way.

Gullies.—The gullies for the surface drainage to be placed as shown on plan, and encased with 4½ inch brickwork built in cement to the height required, and covered with existing cast-iron gratings, and the connections to gully drains to be made good with Portland cement.

Pitching.—The carriage way to be pitched with 9-inch hard rock pitching or other approved material, set on edge with the widest edge downwards, all projecting edges to be broken off and the interstices to be filled in with stones of equal quality to form a smooth surface, which must be thoroughly consolidated.

Macadam.—The whole of the carriage way to be covered with 7 inches of consolidated Penmaenmaur or Port Nant macadam in two coverings, broken so that the largest dimensions of any piece shall not exceed 2 inches. The first coat to be uniformly spread, immediately after the pitching is pronounced to be satisfactory by the surveyor, and to be well rolled with a steam roller. The second coat to be uniformly applied and well rolled with a steam roller without any blinding, so as to fix each stone in its place, after which the whole surface to be very lightly blinded with macadam chippings and well watered and rolled.

Channels.—To be hard, gray, best quality Haslingden stone from the lower beds 15 inches by 7 inches thick and not less than 3 feet in length, and to be firmly and solidly bedded on gravel or cinders laid on rock pitching, the upper surface if not self faced and perfectly true, must be accurately worked out of winding, the bed even and parallel to the face, one side and ends truly jointed and the macadam side pitched off to line and the joints racked with pea gravel and boiling asphalt, all turns to have granite channels 15 inches by 7 inches worked to the required radii.

Passage crossings.—All crossings to have four courses of hard, gray, best quality Haslingden stone 12 inches by 7 inches thick, truly faced, and square jointed through ends and sides, and in not less than 2 feet 6 inch lengths. Pave between the courses with single runs of Clee Hill sets, and make out the full width of crossing with similar paving, and rack the joints with clean pea gravel and Portland cement.

Curbstones.—To be best quality hard, gray, Haslingden stone 12 inches by 6 inches dressed on top splazed face and 3 inches down the back, the remainder to be hammer dressed, the joints to be neatly and accurately squared throughout the entire depth, and no stone to be less than 3 feet in length. All turns to be granite 12 by 6 from approved quarries and to the required radii.

*Foundation of footways.**—The footways to be carefully leveled and formed by excavating or filling in the ground for the site (care being taken to reserve the old wood fence on west side for re-erection) in accordance with the drawings, and a foundation formed of a bed of cinders or gravel 3 inches deep, well pommed.

Flagging.—The footpaths to be laid with 3-inch hard, gray, best quality Haslingden flags, taken out of winding. No flag to be less than 4 feet superficial, and not less than 1 foot 9 inches wide. The joints to be well squared (not pitched off), and jointed with hydraulic lime mortar in the proportions of one of lime to two of clean, sharp sand, and to be well bedded and driven close to joint, and when necessary the flags shall be cut to the steps or other projections and all holes cut for pins, gas columns and water boxes. The flagging when complete shall have a fall towards the channel of $\frac{1}{2}$ inch to the foot.

Lamp columns.—Provide and fix where shown on plan extra lamp columns and heads equal to sample, and allow £15 0s. 0d. for gas company's charges.

ISAAC DIXON,
Surveyor.

JULY, 1890.

In the Garston local district, adjoining Liverpool, macadamized and "bituminous concrete" carriageways are favorites. Official specifications for each are annexed.

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* Street crossings. To have three courses of granite 16 inches by 8 inches grooved, truly faced and square jointed through ends and sides, and in not less than 3 feet lengths and paved to full width of adjoining footpath with granite sets racked with pea gravel and boiling asphalt. Street curbstones: To be hard, gray, Haslingden stone 12 inches by 6 by 5 and all turns to be granite 12 by 6 by 5 from approved quarries and to the required radii.

DISTRICT OF GARSTON.

Description of Works (No. 1).

SEWERS.

Excavation.—The contractor shall carry out all the excavations required, and shall excavate the trenches to such lengths, breadths, and depths as the engineer may direct, and shall form the bottoms of the same as hereinafter specified. In no case shall the trench be less than 12 inches wider than the external diameter of the sewer to be laid therein. The contractor must be careful in opening the trenches not to remove more of the road surface than, in the opinion of the engineer, is necessary for the proper execution of the work, and must not resort to blasting without the permission of the engineer.

Refilling.—The contractor shall, after the sewers have been laid in the manner hereinafter described, fill in the earth in 6-inch layers, and well water and pun the same until thoroughly consolidated.

Reinstatement.—The contractor shall in all cases reinstate and make good the roads, footpaths, and other surfaces affected by his operations.

Surplus earth.—All surplus earth and superfluous rubbish shall be removed and carted away by and at the expense of the contractor, who shall find a place of deposit for the same.

Pipe sewers.—The contractor shall provide and lay in the respective positions shown on plan, and at the respective depths shown on sections, the requisite lengths of pipe sewers of the following sizes:

Fifteen inches diameter at least 1¼ inches thick.

Twelve inches diameter at least $1\frac{1}{10}$ inches thick.

Nine inches diameter at least seven-eighths inch thick.

Six inches diameter at least three-fourths inch thick.

Mode of laying sewers.—In all cases where practicable the sewers shall be laid in open trenches, and no heading or tunnel will be permitted except with the written sanction of the engineer, and where such permission is given, the heading or tunnel shall be open from end to end before any portion of the sewer is laid. The pipes shall be laid singly, and joint holes to receive the sockets must in all cases be made in the bottom of the trench, so that the full length of each pipe between joint and joint may have a bearing on the solid ground.

Mode of jointing pipes.—All pipes shall be jointed with tarred yarn, calked into the sockets, and flushed up with well puddled clay.

Junctions.—The contractor shall provide and fix in the positions shown on the plan or where required, properly formed V junction pipes as under, for connecting gullies and private drains with the main sewers.

Number ——, 15 inches diameter.

Number ——, 12 inches diameter.

Number ——, 9 inches diameter.

Number ——, 6 inches diameter.

It is to be particularly noted that in no case will right-angle junctions be allowed, and that no connection will be permitted to be made by cutting into the pipes.

Stoneware disks.—The contractor shall provide and fix stoneware disks, as under:

Number ——, 12 inches diameter.

Number ——, 9 inches diameter.

Number ——, 6 inches diameter.

The disks must be carefully fitted and securely clayed into the branches of the junction pipes.

Galvanized iron indicators.—The contractor shall provide number —— galvanized iron indicators, of form and dimensions shown on drawing for pointing out the posi-

tions of the junctions, and shall fix them as directed by the engineer, either for the walls, fences, or to stakes 3 inches by 2 inches, driven 2 feet into the ground.

Manholes.—The contractor shall build manholes in the situations shown on plan, in 9-inch brickwork set in Portland cement to top of pipe sewer, and best lias lime mortar the remainder, and of the respective forms and dimensions shown on sections and detail drawings.

Manhole covers.—The contractor shall provide and fix on the tops of the manholes, cast-iron covers of form, size, and weight, and similar in every respect to the covers used by the Garston local board.

Foot irons.—The contractor shall provide and fix the requisite number of foot irons of galvanized wrought-iron bar of the form, size, and similar in every respect to those used by the local board. They are to be placed four courses of brickwork apart, vertically, flattened through the thickness of the walls, and the ends turned up 1½ inches.

Gullies.—The contractor shall provide and fix in the position shown on plan, or where required, 9-inch brick gullies, built in Portland cement, of the form and dimensions shown on detail drawing. Each gully shall have the brickwork carried to the top for the reception of iron gratings, and be connected to the sewers by 6-inch diameter glazed stoneware socket pipes, with syphon blocks laid at one inclination throughout.

Gully gratings.—The contractor shall provide and fix on the top of each gully a cast-iron grating of form, size, and weight and in every respect similar to those used by the local board. Each grating must be firmly bedded on the brickwork in best blue lias lime mortar.

ROADS.

Surface excavation.—The contractor shall remove all obstructions and shall excavate the carriageway to a line 18 inches below the sectional line on drawing No. ——.

Filling.—The contractor shall fill in the ground where required to the level prescribed in the preceding clause (No. 48) with approved material.

Foundation of carriageways.—The contractor shall properly form, roll with horse roller, and water the surfaces for the reception of the road material, and shall hand pitch the whole area of the intended carriageway to a depth of 10 inches with hard rock pitching to the satisfaction of the engineer, the interstices to be well racked up with rock broken small and well rolled with the steam roller.

Superstructure of carriageways.—The contractor shall provide and lay two coats of macadam over the whole area of the carriageway of a total thickness of 6 inches. The first layer, 3 inches thick, shall be composed of good, hard rock stone, broken by hand, small enough to pass through a 2½-inch ring in every direction, blinded with one-half inch of gravel sand of quality specified, and rolled with the local board steam roller until, in the opinion of the engineer, it is sufficiently consolidated to receive the second layer. The contractor shall, on receipt of notice in writing from the engineer, spread a second layer 3 inches thick composed of Penmaenmawr stone, broken by hand, small enough to pass through a 1¾-inch ring in every direction; blind the same throughout with 1 inch of gravel sand of quality specified, and roll the whole area with the steam roller, and water and sweep the same until it is, in the opinion of the engineer, thoroughly consolidated.

Rollers.—The local board steam roller may be hired from the works committee at a charge of 30*s.* per day (including fuel and water), and the horse roller at a charge of 5*s.* per day (excluding horses).

Channels.—The channels shall consist of hard-tooled York stone channel blocks 12 by 6 inches, each stone to be at least 2 feet long, laid to the inclinations longitudinal and transverse, shown on drawing No. ——. They shall be bedded on 2 inches of gravel sand on a hard rock foundation 3 inches deep, and well cramped and bedded solid.

Curbing.—The contractor shall provide and fix the requisite lengths of straight, hard York stone-tooled curbing, 5 inches thick and 12 inches deep. The curbing throughout to be in not less than 3 feet lengths, to be well bedded on 2 inches of gravel sand on a hard rock foundation 3 inches deep, and truly laid and close-jointed. The radiated corners to consist of granite curbs, 5 inches thick and 12 inches deep, laid in the same manner as the York curbs.

Street crossings.—The contractor shall provide and lay crossings where shown on drawing, formed of three rows of hard machine-faced squared York stone crossing blocks, 16 by 7 inches, with V grooves 1 inch wide by three-quarters inch deep in center, and nine rows of Clee Hill sets 7 by 6 by 3 inches, the blocks and sets to be laid on beds of good lias lime and rock concrete 6 inches deep, in 2 inches of good gravel sand, and all the joints to be racked with asphalt, coal pitch, and creosote oil, to be used while hot, and limestone clippings.

Footways.—The contractor shall excavate or fill up the ground as may be required to a line 6 inches below the sectional line on drawing No. ——, and shall form the ground with good hard material to the profile shown on cross-sections, and consolidate the same by horse rolling, watering, or otherwise, as may be required. The footways throughout shall be paved with patent Victoria stone on beds of engine ashes 3 inches deep, and good mortar beds close-jointed with good fine mortar of the requisite fluidity, the radiated corners to be worked according to details, all the stones to be well and solidly bedded.

Old materials.—The contractor must value the old materials (if any) at present on the ground, and must state in his tender the amount he will allow for the same.

QUALITY OF MATERIALS.

Stoneware drain pipes.—The whole of the pipes shall be approved salt-glazed stoneware socket pipes of the best manufacture, sound and thoroughly burnt throughout their whole substance, and the internal and external surfaces smooth and well-glazed. They shall be cylindrical in bore, and internally of the full specified diameter, and shall have whole socket-joints forming a component part of the pipe. The thickness shall be uniform throughout the entire body of the pipe.

No square junctions shall be used.

All pipes shall be made to fit without being chipped.

Lime —The lime shall be blue lias or other approved hydraulic lime, fresh burnt, and until used in mortar, shall be protected from wet, and as much as possible from the atmosphere.

Portland cement.—The cement used in the works of this contract shall be fresh-burnt Portland cement (obtained from the Rugby Portland Cement Company), of such fineness that samples sifted through a No. 50 gauge wire sieve shall not leave a residue of more than 10 per cent., and of such quality and strength that samples of pure cement, when gauged neat in the ordinary brass moulds shall not become firm in less than 3 hours, and shall, after 7 days' immersion in water, be capable of bearing a tensile strain of 400 pounds on the sectional area of 1 square inch.

Sand.—The sand for mortar shall be clean and sharp, free from all foreign matter, and screened if required by the engineer.

The sand for blinding macadam shall be beach-gravel sand, of quality approved by the engineer, a sample of which may be seen at his office.

Lime mortar.—The lime mortar shall be composed of two parts of best building sand, of approved quality, to one part of lime.

Portland cement mortar.—Portland cement mortar shall be composed of two parts of best building sand, of approved quality, to one part of Portland cement.

Brickwork.—The whole of the brickwork shall be built in Old English bond, unless otherwise directed, lineable, plumb, and solid throughout, carried up uniformly with the facework, and closely bedded in mortar, so that in no case shall four courses, when built, exceed in height four like courses set dry, by more than 1¼ inches, and in order

that every joint may be filled, the brickwork must be completely flushed with mortar of the requisite fluidity. No broken bricks will be allowed except for closers.

The whole of the bricks, except where otherwise specified, shall be best common bricks, hard, sound, and well burnt, of approved quality.

HENRY T. WAKELAM,
Assoc. M. Inst., C. E., Engineer and Surveyor.

DESCRIPTION OF WORKS (No. 2).

SEWERS.

Excavation.—The contractor shall carry out all the excavations required, and shall excavate the trenches to such lengths, breadths, and depths as the engineer may direct, and shall form the bottoms of the same as hereinafter specified. In no case shall the trench be less than 12 inches wider than the external diameter of the sewer to be laid therein. The contractor must be careful in opening the trenches not to remove more of the road surface than in the opinion of the engineer is necessary for the proper execution of the work, and must not resort to blasting without the permission of the engineer.

Refilling.—The contractor shall, after the sewers have been laid in the maner hereinafter described, fill in the earth in 6-inch layers, and well water and pound the same until thoroughly consolidated.

Reinstatement of streets, footpaths, etc.—The contractor shall in all cases reinstate and make good the roads, footpaths, and other surfaces affected by his operations.

Surplus earth.—All surplus earth and superfluous rubbish shall be removed and carted away by and at the expense of the contractor, who shall find a place of deposit for the same.

Pipe sewers.—The contractor shall provide and lay in the respective positions shown on plan, and at the respective depths shown on sections, the requisite lengths of pipe sewers, of the following sizes:

Fifteen inches diameter at least $1\frac{1}{4}$ inches thick.

Twelve inches diameter at least $1\frac{1}{10}$ inches thick.

Nine inches diameter at least $\frac{7}{8}$ inch thick.

Six inches diameter at least $\frac{3}{4}$ inch thick.

Mode of laying sewers.—In all cases where practicable the sewers shall be laid in open trenches, and no heading or tunnel will be permitted except with the written sanction of the engineer, and where such permission is given the heading or tunnel shall be open from end to end before any portion of the sewer is laid. The pipes shall be laid singly, and joint holes to receive the sockets must in all cases be made in the bottom of the trench, so that the full length of each pipe between joint and joint may have a bearing on the solid ground.

Mode of jointing pipes.—All pipes shall be jointed with tarred yarn, calked into the sockets, and flushed up with well puddled clay.

Junctions.—The contractor shall provide and fix in the positions shown on the plan or where required, properly formed **V** junction pipes as under, for connecting gullies and private drains with the main sewers.

Number ——, 15 inches diameter.

Number ——, 12 inches diameter.

Number ——, 9 inches diameter.

Number ——, 6 inches diameter.

It is to be particularly noted that in no case will right angle junctions be allowed, and that no connection will be permitted to be made by cutting into the pipes.

Stoneware disks.—The contractor shall provide and fix stoneware disks, as under-·

Number ——, 12 inches diameter.

Number ——, 9 inches diameter.
Number ——, 6 inches diameter.
The disks must be carefully fitted and securely clayed into the branches of the junction pipes.

Galvanized iron indicators.—The contractor shall provide number —— galvanized iron indicators of form and dimensions shown on drawing for pointing out the positions of the junctions, and shall fix them as directed by the engineer either to the walls, fences, or to stakes 3 inches by 2 inches, driven 2 feet into the ground.

Manholes.—The contractor shall build manholes in the situations shown on plan in 9-inch brickwork set in Portland cement to top of pipe sewer, and best lias lime mortar the remainder, and of the respective forms and dimensions shown on sections and detail drawings.

Manhole covers.—The contractor shall provide and fix on the tops of the manholes cast-iron covers of form, size, and weight, and similar in every respect to the covers used by the Garston local board.

Foot irons.—The contractor shall provide and fix the requisite number of foot-irons, of galvanized wrought-iron bar, of the form, size, and similar in every respect to those used by the local board. They are to be placed four courses of brick apart vertically, flattened through the thickness of the walls, and the ends turned up 1½ inches.

Gullies.—The contractor shall provide and fix in the position shown on plan, or where required, 9-inch brick gullies, built in Portland cement, of the form and dimensions shown on detail drawing. Each gully shall have the brickwork carried to the top for the reception of iron gratings, and be connected to the sewers by 6-inch diameter glazed stoneware socket pipes, with syphon blocks laid at one inclination throughout.

Gully gratings.—The contractor shall provide and fix on the top of each gully a cast-iron grating, of form, size, and weight and in every respect similar to those used by the local board. Each grating must be firmly bedded on the brickwork in the best blue lias lime mortar.

ROADS.

Surface excavation.—The contractor shall remove all obstructions, and shall excavate the carriageway to a line 18 inches below the sectional line on drawing No. ——.

Filling.—The contractor shall fill in the ground, where required, to the level prescribed in the preceding clause (No. 48) with approved material.

Foundation of carriageways.—The contractor shall properly form, roll with horse roller, and water the surface for the reception of the road material, and shall hand pitch the whole area of the intended carriageway to a depth of 10 inches with hard rock pitching to the satisfaction of the engineer, the interstices to be well racked up with rock broken small, and well rolled with the steam roller.

Superstructure of carriageways.—The contractor shall provide and lay two coats of macadam over the whole of the carriageway to a total thickness of 6 inches. The first layer, 3 inches thick, shall be composed of good hard rock stone, broken by hand small enough to pass through a 2½-inch ring in every direction, blinded with ½ an inch of gravel sand of quality specified, and rolled with the local board steam roller until, in the opinion of the engineer, it is sufficiently consolidated to receive the second layer. The contractor shall, on receipt of notice in writing from the engineer, spread the second layer 3 inches thick, composed of Penmaenmawr stone, broken by hand small enough to pass through a 1¾-inch ring in every direction; the stone to be first well and thoroughly mixed with hot boiled tar and pitch, and then evenly spread and rolled with the steam roller, and then blind the same with an inch of limestone chippings, to pass through a ¾-inch riddle, and not smaller than will pass through a ½-inch riddle, well and thoroughly mixed with hot boiled pitch and tar, evenly spread, and afterward blinded with a coating of fine dry chippings

and rolled with the steam roller until it is, in the opinion of the engineer, thoroughly consolidated.

Rollers.—The local board steam roller may be hired from the works committee at at a charge of 30*s.* per day (excluding fuel and water), and the horse roller at a charge of 5*s.* per day (excluding horses).

Channels.—The channels shall consist of hard-tooled York stone channel blocks 12 by 6 inches, each stone to be at least 2 feet long, laid to the inclinations longitudinal and transverse shown on drawing No. ——. They shall be bedded on 2 inches of gravel sand, on a hard rock foundation 3 inches deep, and well cramped and bedded solid.

Curbing.—The contractor shall provide and fix the requisite lengths of straight hard York stone tooled curbing, 5 inches thick and 12 inches deep. The curbing throughout to be in not less than 3-feet lengths, to be well bedded on 2 inches of gravel sand on a hard rock foundation 3 inches deep, and truly laid and close-jointed. The radiated corners to consist of granite curbs 5 inches thick and 12 inches deep, laid in the same manner as the York curbs.

Street crossings.—The contractor shall provide and lay crossings where shown on drawing, formed of three rows of hard machine-faced squared York stone crossing blocks, 16 inches by 7 inches, with V grooves 1 inch wide by ¾ inch deep in center, and nine rows of Clee Hill sets 7 inches by 6 inches by 3 inches, the blocks and sets to be laid on beds of good lias lime and rock concrete 6 inches deep in 2 inches of good gravel sand, and all the joints to be racked with asphalt, coal pitch, and creosote oil, to be used whilst hot, and limestone chippings.

Footways.—The contractor shall excavate or fill up the ground as may be required to a line 6 inches below the sectional line on drawing No. ——, and shall form the ground with good hard material to the profile shown on cross-sections, and consolidate the same by horse rolling, watering, or otherwise, as may be required. The footways throughout shall be paved with patent Victoria stone on beds of engine ashes 3 inches deep, and good mortar beds close-jointed with good fine mortar of the requisite fluidity, the radiated corners to be worked according to details, all the stones to be well and solidly bedded.

Old materials.—The contractor must value the old materials (if any) at present on the ground, and must state in his tender the amount he will allow for the same.

QUALITY OF MATERIALS.

Stoneware drain pipes.—The whole of the pipes shall be approved salt-glazed stoneware socket pipes of the best manufacture, sound, and thoroughly burnt throughout their whole substance, and the internal and external surfaces smooth and well glazed. They shall be cylindrical in bore, and internally of the full specified diameter, and shall have whole socket joints forming a component part of the pipe. The thickness shall be uniform throughout the entire body of the pipe.

No square junctions shall be used.

All pipes shall be made to fit without being chipped.

Lime.—The lime shall be blue lias or other approved hydraulic lime, fresh burnt, and until used in mortar, shall be protected from wet, and as much as possible from the atmosphere.

Portland cement.—The cement used in the works of this contract shall be fresh-burnt Portland cement (obtained from the Rugby Portland Cement Company), of such fineness that samples sifted through a No. 50 gauge wire sieve, shall not leave a residue of more than 10 per cent., and of such quality and strength that samples of pure cement, when gauged neat in the ordinary brass molds, shall not become firm in less than 3 hours, and shall, after 7 days' immersion in water, be capable of bearing a tensile strain of 400 pounds on the sectional area of 1 square inch.

Sand.—The sand for mortar shall be clean and sharp, free from all foreign matter, and screened, if required, by the engineer.

The sand for blinding macadam, shall be beach-gravel sand, of quality approved by the engineer, a sample of which may be seen at his office.

Lime mortar.—The lime mortar shall be composed of two parts of best building sand of approved quality to one part of lime.

Portland cement mortar.—Portland cement mortar shall be composed of two parts of best building sand of approved quality to one part of Portland cement.

Brickwork.—The whole of the brickwork shall be built in old English bond, unless otherwise directed, lineable, plumb, and solid throughout, carried up uniformly with the facework, and closely bedded in mortar, so that in no case shall four courses, when built, exceed in height four like courses set dry, by more than 1¼ inches, and in order that every joint may be filled, the brickwork must be completely flushed with mortar of the requisite fluidity. No broken bricks will be allowed except for closers.

The whole of the bricks, except where otherwise specified, shall be best common bricks, hard, sound, and well burnt, of approved quality.

HENRY T. WAKELAM,
Assoc. M. Inst. C. E., Engineer and Surveyor.

DESCRIPTION OF WORKS (NO. 3).

SEWERS.

Excavation.—The contractor shall carry out all the excavations required, and shall excavate the trenches to such lengths, breadths, and depths as the engineer may direct, and shall form the bottoms of the same as hereinafter specified. In no case shall the trench be less than 12 inches wider than the external diameter of the sewer to be laid therein. The contractor must be careful in opening the trenches not to remove more of the road surface than in the opinion of the engineer is necessary for the proper execution of the work, and must not resort to blasting without the permission of the engineer.

Refilling.—The contractor shall, after the sewers have been laid in the manner hereinafter described, fill in the earth in 6-inch layers, and well water and pound the same until thoroughly consolidated.

Reinstatement.—The contractor shall in all cases reinstate and make good the roads, footpaths, and other surfaces affected by his operations.

Surplus earth.—All surplus earth and superfluous rubbish shall be removed and carted away by and at the expense of the contractor, who shall find a place of deposit for the same.

Pipe sewers.—The contractor shall provide and lay in the respective positions shown on plan, and at the respective depths shown on sections, the requisite lengths of pipe sewers of the following sizes:

15 inches diameter at least 1¼ inches thick.
12 inches diameter at least 1$\frac{1}{10}$ inches thick.
9 inches diameter at least ⅞ inch thick.
6 inches diameter at least ¾ inch thick.

Mode of laying sewers.—In all cases where practicable the sewers shall be laid in open trenches, and no heading or tunnel will be permitted except with the written sanction of the engineer, and where such permission is given the heading or tunnel shall be open from end to end before any portion of the sewer is laid. The pipes shall be laid singly, and joint holes to receive the sockets must in all cases be made in the bottom of the trench, so that the full length of each pipe between joint and joint may have a bearing on the solid ground.

Mode of jointing pipes.—All pipes shall be jointed with tarred yarn, caulked into the sockets, and flushed up with well puddled clay,

Junctions.—The contractor shall provide and fix in the positions shown on the plan or where required, properly formed V junction pipes as under, for connecting gullies and private drains with the main sewers.

Number —— 15 inches diameter.
Number —— 12 inches diameter.
Number —— 9 inches diameter.
Number —— 6 inches diameter.

It is to be particularly noted that in no case will right angle junctions be allowed, and that no connection will be permitted to be made by cutting into the pipes.

Stoneware disks.—The contractor shall provide and fix stoneware disks, as under:

Number —— 12 inches diameter.
Number —— 9 inches diameter.
Number —— 6 inches diameter.

The disks must be carefully fitted and securely clayed into the branches of the junction pipes.

Galvanized iron indicators.—The contractor shall provide number —— galvanized iron indicators, of form and dimensions shown on drawing for pointing out the positions of the junctions, and shall fix them as directed by the engineer, either to the walls, fences, or to stakes 3 inches by 2 inches, driven 2 feet into the ground.

Manholes.—The contractor shall build manholes in the situations shown on plan, in 9-inch brickwork, set in Portland cement to top of pipe sewer, and best lias lime mortar the remainder, and of the respective forms and dimensions shown on sections and detail drawings.

Manhole covers.—The contra ctor shall provide and fix on the tops of the manholes cast-iron covers of form, size, and weight, and similar in every respect to the covers used by the Garston local board.

Foot irons.—The contractor shall provide and fix the requisite number of foot irons, of galvanized wrought-iron bar, of the form, size, and similar in every respect to those used by the local board. They are to be placed four courses of brickwork apart vertically, flattened through the thickness of the walls, and the ends turned up 1½ inches.

Gullies.—The contractor shall provide and fix in the position shown on plan, or where required, 9-inch brick gullies, built in Portland cement, of the form and dimensions shown on detail drawing. Each gully shall have the brickwork carried to the top for the reception of iron gratings, and be connected to the sewers by 6-inch diameter glazed stoneware socket pipes, with siphon blocks laid at one inclination throughout.

Gully gratings.—The contractor shall provide and fix on the top of each gully a cast-iron grating, of form, size, and weight, and in every respect similar to those used by the local board. Each grating must be firmly bedded on the brickwork in best blue lias lime mortar.

ROADS.

Surface excavation.—The contractor shall remove all obstructions, and shall excavate the carriageway to a line 12 inches below the sectional line on drawing No.——

Filling.—The contractor shall fill in the ground where required to the level prescribed in the preceding clause (No. 48) with approved material.

Construction.—The contractor shall provide and lay over the whole of the carriageway good concrete, spread to a depth of 6 inches, laid to the curvature of road; the concrete to be composed of two parts of good hard rock, or other approved stone, broken to pass a 2-inch ring, two parts good clean gravel sand and one part good Portland cement, and shall afterwards provide and lay over the whole surface 4 inches by 4 inches by 4 inches Clee Hill sets (second quality), laid in a bed of gravel sand 2 inches deep; all the joints to be racked with coal pitch, creosote oil, and boiled coal tar asphalt used whilst hot, and limestone chippings; and the whole surface of the carriageway shall afterwards be covered with a layer of asphalt at least one-quarter of an inch in thickness composed as above.

Channels.—The channels shall consist of hard-tooled York stone channel blocks 12 by 6 inches, each stone to be at least 2 feet long, laid to the inclinations longitudinal and transverse, shown on drawings. They shall be bedded on 2 inches of gravel sand on a hard rock foundation 3 inches deep and well cramped and bedded solid.

Curbing.—The contractor shall provide and fix the requisite lengths of straight hard York stone-tooled curbing, 5 inches thick and 12 inches deep. The curbing throughout to be in not less than 3 feet lengths, to be well bedded on 2 inches of gravel sand on a hard-rock foundation 3 inches deep, and truly laid and close jointed. The radiated corners to consist of granite curbs, 5 inches thick and 12 inches deep, laid in the same manner as the York curbs.

Street crossings.—The contractor shall provide and lay crossings where shown on drawing, formed of three rows of hard machine-faced squared York stone crossing blocks, 16 inches by 7 inches, with V grooves 1 inch wide by three-fourths of an inch deep in center, and nine rows of Clee Hill sets 7 inches by 6 inches by 3 inches, the blocks and sets to be laid on beds of good lias lime and rock concrete to 6 inches deep in 2 inches of good gravel sand, and all the joints to be racked with asphalt, coal pitch, and creosote oil, to be used while hot, and limestone chippings.

Footways.—The contractor shall excavate or fill up the ground as may be required to a line 6 inches below the sectional line on drawing No.——, and shall form the ground with good hard material to the profile shown on cross sections, and consolidate the same by horse rolling, watering, or otherwise, as may be required. The footways throughout shall be paved with patent Victoria stone, on beds of engine ashes 3 inches deep, and good mortar beds close jointed with good fine mortar of the requisite fluidity, the radiated corners to be worked according to details, all the stones to be well and solidly bedded.

Old materials.—The contractor must value the old materials (if any) at present on the ground, and must state in his tender the amount he will allow for the same.

QUALITY OF MATERIALS.

Stoneware drain pipes.—The whole of the pipes shall be approved salt-glazed stoneware socket pipes of the best manufacture, sound, and thoroughly burnt throughout their whole substance, and the internal and external surfaces smooth and well glazed. They shall be cylindrical in bore, and internally of the full specified diameter, and shall have whole socket joints forming a component part of the pipe. The thickness shall be uniform throughout the entire body of the pipe.

No square junctions shall be used.

All pipes shall be made to fit without being chipped.

Lime.—The lime shall be blue lias or other approved hydraulic lime, fresh burnt, and until used in mortar, shall be protected from wet, and as much as possible from the atmosphere.

Portland cement.—The cement used in the works of this contract shall be fresh-burnt Portland cement (obtained from the Rugby Portland Cement Co.); of such fineness that samples sifted through a No. 50 gauge wire sieve shall not leave a residue of more than 10 per cent., and of such quality and strength that samples of pure cement, when gauged neat in the ordinary brass molds, shall not become firm in less than 3 hours, and shall, after 7 days' immersion in water, be capable of bearing a tensile strain of 400 pounds on the sectional area of 1 square inch.

Sand.—The sand for mortar shall be clean and sharp, free from all foreign matter, and screened if required by the engineer.

The sand for blinding macadam shall be beach-gravel sand, of quality approved by the engineer, a sample of which may be seen at his office.

Lime mortar.—The lime mortar shall be composed of two parts of best building sand, of approved quality, to one part of lime.

Portland cement mortar.—Portland cement mortar shall be composed of two parts of best building sand, of approved quality, to one part of Portland cement.

Brickwork.—The whole of the brickwork shall be built in old English bond, unless otherwise directed, lineable, plumb, and solid throughout, carried up uniformly with the facework, and closely bedded in mortar, so that in no case shall four courses, when built, exceed in height four like courses set dry, by more than 1¼ inches, and in order that every joint may be filled, the brickwork must be completely flushed with mortar of the requisite fluidity. No broken bricks will be allowed except for closers.

The whole of the bricks, except where otherwise specified, shall be best common bricks, hard, sound, and well burnt, of approved quality.

HENRY T. WAKELAM,
Assoc. M. Inst., C. E., Engineer and Surveyor.

It is evident that in this region macadamized roads are believed to be the best and most economical. I can not therefore do better than annex hereto a paper on "The maintenance of macadamized roads" by W. Hewitt, read at the ordinary general meeting of the Surveyors Institution, November 26, 1888.

I also inclose an official report by Thomas Codrington, C. E., etc., on road maintenance.

Land values undoubtedly are enhanced by good roads, but it is quite impossible to estimate to what extent in this densely populated district.

THOS. H. SHERMAN,
Consul.

UNITED STATES CONSULATE,
Liverpool, March 14, 1891.

MACADAMIZED ROADS.*

BY W. HEWITT.

[Inclosure in Consul Sherman's report.]

Road maintenance is a subject to which comparatively little attention has been given in this country, although it is one of great importance, involving, as it does, inclusive of the metropolitan macadamized roads, an annual expenditure of nearly £4,500,000. In the early part of the last century the roads were little more than cart tracks, on which, when they got in a very bad condition, a quantity of stone of various sizes were placed indiscriminately and left to work in. Of course a road maintained in such a way as this was always in a bad condition, except when the stone was newly put on, and then it was too rough and uneven for the traffic to pass easily over it. In some districts where stone was scarce the road would be mended in the autumn with brushwood, mud, etc., with a layer of stone on the top; but in a short time this road, especially in wet weather, became in a much worse state than before. The method of making a new road was to dig a trench of the required width and deposit a layer of large stones in it and another of small on the top of them. This was left to itself and allowed to consolidate in the best way it could. The thickness of these layers varied according to the idea of the surveyor, and, as he was generally a man possessing no experience of road making or maintaining, it was not to be expected that he would know anything about the work he had to superintend. Things went on in this way until the establishment by law of turnpike trusts.

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* Read at the ordinary general meeting of the Surveyors' Institution, November 26, 1888.

But it appears this did not do much good. The trusts were in short lengths, sometimes not more than 20 miles, and the surveyors were no better than before, as they were more frequently appointed by favor than for any qualifications which they possessed for the office.

This state of things continued until the time of Macadam and Telford (about the commencement of the present century), when great improvements were made; the stone was broken to a more uniform size, and greater attention was paid to drainage. Macadam's principle was "to put broken stone upon a road which shall unite by its own angles so as to form a solid, hard surface," and this by universal experience since has been allowed to be correct. He also contended that no greater convexity should be given to the cross-section of a road than was necessary to carry off the surface water into the water-tables. He did not agree with Telford in one important particular, namely, that a road should have some sort of hard foundation, either a rough hand-set pavement, or a layer of rough stone or gravel for the broken stone to be placed on, preferring to lay the metalling on the formation surface. Experience, however, has since shown that Telford's method was the right one. A great deal has been said about the disagreement between these two eminent men on this particular subject, but it is very evident that they agreed in a great deal more than they differed; and it is by a combination of their methods, united with recent improvements, that the best roads are now made and maintained. In laying out a new road the general lines must always be controlled, more or less, by the surface formation of the locaiity. Cuttings and embankments should be avoided as much as possible, owing to their great expense, and when unavoidable the work should be so arranged, as far as possible, that the soil removed in cutting can be used for the embankment. It is essential that the formation of a road should be thoroughly drained, whether it has a paved bottom or not. This is usually done by ditches on each side of the road. They should be from 2 feet to 3 feet below the level of the surface of the road. They are sometimes on the land side of the fence, and sometimes on the road side; but it is preferable to have them on the latter, as the roadmen can more easily get at them to clean them out, and it also gives a greater width between the fences, which is a great aid in drying the road, as the air has freer access to it. When the ditches are on the land side of the fence, in most cases they belong to the owners of the property, and the occupiers are supposed to clean and scour them, which there is sometimes great difficulty in getting them to do. When they are on the road side there should be, unless there are footpaths, and when the width will allow, sod borders between the metalled portion of the road and the side ditches, with outlet cuts at short intervals to lead the water away from the surface of the road. In some parts of the country great objection has been made by some members of highway boards to their formation, and they assert that sod borders cause greater expense in the maintenance of the road. This, however, is an error; they may be formed and maintained very inexpensively, and it does not cost nearly so much for trimming the edges and cleaning the outlets as it does to clean the sides of a road by stocking up the weeds and grass. These always accumulate where, as on most country roads, the whole width is not used, and where there is no sod border there is always great expense caused by these operations, which injure the road by admitting the wet, besides being very unsightly; whereas the sod border, when properly kept and trimmed, adds to the appearance of the road and facilitates the flowing away of the surface water. It should be from 4 to 6 inches high, as this would not be high enough to endanger vehicles, and yet high enough to keep anyone from driving into the ditches in the dark.

Where there are many houses on the sides of the road it becomes necessary to have a footpath, and this should be formed over the side ditch, as it is always better to have a drain under the footpath than under the road. In such a case it is always best to lay some kind of curbing and channeling at the side of the road, the nature of which must be determined by the locality, as when once down it costs less in such a situation to keep clean than anything else would. Small drains communi-

cating with the underdrains should be carried under the footpath at intervals, so as to carry off the surface water. All side ditches, outlets, borders, etc., should be thoroughly cleaned out and trimmed in the autumn, and gone over again where necessary in the spring. If this work is done in the summer it causes a great deal of useless trouble and expense, as the grass and weeds then grow so rapidly, necessitating the doing of the work over again. In addition to the side drains cross drains are necessary in most cases so as to thoroughly drain the center of the foundation of the road. These are usually pipe-drains and should communicate directly with the side drains, the fall from the center to the sides being from 1 in 80 to 1 in 100. In districts where stone is plentiful box drains are generally used, as being much cheaper. They are of square section, and are formed with flat stones for the top and bottom, and stone sides. The great advantage of these drains is that they can be so readily opened for cleaning by taking off the top stones. Sometimes it is advantageous to construct miter or V drains. They are formed as ordinary drains, but in the shape of a flat V, with the center uphill. In many instances a cheap and effective drain may be formed by cutting a trench about a foot square in the formation surface and filling it with large rough stones. The intervals at which these drains should be placed must depend on the nature of the subsoil and the quantity of water in it. With a clay subsoil they must be at shorter intervals than in gravel or sandy soil. Where there are footpaths, catch-pits or gullies may be used for the surface water, and should be connected directly with the cross drains. Any springs that may make their appearance must be immediately tapped and led away to the side ditches.

With a good system of cross-drainage there is no advantage in constructing longitudinal drains immediately under the water-tables in addition to the side drains. On roads which are formed on sidelong ground and benched into the hillside, it is nearly always necessary to have a drain in the side of the hill above the road to keep the land water from the road; but the form of this must be determined by local circumstances. A very common and inexpensive way is by cutting a deep trench and filling it with large stones. Whatever system may be adopted in such cases, the drains should be connected, at intervals, directly with culverts, so as to convey the water under the road and away from the upper side as quickly as possible. In many instances, particularly in hilly districts, no outlet can be found for the water on one side of the road. In such cases provision must be made for conveying it under the road at intervals by means of large drains or culverts. These are usually pipes of large diameter, or may be large box-drains, with the walls either built dry or with mortar; the larger ones being generally built with brick or stone walls, and with a turned arch similar to a bridge. In all cases an invert should be formed, either by an inverted arch or a flat pitched invert, or the walls would be rapidly undermined by the water. Barrel culverts, of circular section and built of bricks, are now rarely used. It will sometimes be found necessary to go to considerable expense to thoroughly drain a road, but in the end it will always be found to be most economical to do so, as a wet, undrained road is always most expensive to keep in good order. All underdrains and culverts, unless of very large size, should have an iron grating at the entrance, to prevent their getting choked with the rubbish which is always brought down at the commencement of a storm. It is essential that the cross-section of a road, when completed, shall be such as will allow the water to flow freely off it; yet care must be taken that it is not too round, or else the traffic will always keep to the center and form ruts, which will retain the water and thus cause great damage to the road by soaking into and thereby weakening it.

The best form for general purposes, I believe, for the cross-section is an arch of a circle, having a fall of 1 in 30 from the center to the sides of the road. A road should never be quite level longitudinally, or the water will stand in the gutters instead of flowing away freely; so that, even in quite level ground, it is better to go to a slight expense to obtain such a fall as will enable the water to get away easily. Steep gradients should be avoided where possible. No road should ever be made with a

gradient steeper than 1 in 30, but 1 in 50 is much better for general purposes, especially when practicable without much greater cost, for the after expense of maintenance will be much less. Great damage is caused to a road by the feet of the horses when drawing heavy loads uphill, and also by the drags on vehicles descending, by causing a disintegration of the surface. Much injury is frequently caused by water scouring the surface of a hilly road, sometimes the whole coat of surface metalling being swept away. When a road is formed by being benched into the hillside a retaining wall is frequently needed to prevent the earth falling on to it. When the cross-section of the road is formed partly by cutting into the hillside and partly by an embankment, a retaining wall will generally be needed on the other side also, and below the road. The section and strength of these walls must always vary very much, and must altogether depend on local surroundings and requirements. The width of a country road should never be less than 16 feet of metalled surface. On a road where there is great traffic the width should be such as will readily accommodate it, and, within certain limits, the wider a road is in proportion to the traffic the less it will cost to keep in good order. The formation surface of a road, when the drainage is completed, should be well rolled, so as to consolidate it, before the foundation is laid on it; the foundation is usually, in the case of streets or roads with heavy traffic, a pavement of rough flat stone set on edge and formed to the same cross section as the road will have when finished, the interstices being filled with small pieces hand-set with a hammer. Sometimes it is of concrete formed to a similar cross-section.

Cinders and slag form a very good foundation when obtainable, as does coarse gravel. In some districts, where stone is scarce, burnt clay is used; but for ordinary roads the foundation is most generally formed of rough stone, often of spalls from the nearest quarry. Whatever the foundation is it should be well rolled before the surface metalling is laid. Oftentimes the metalling is laid direct on the formation surface. The generality of existing roads are formed in this way, but it is not well to do so if it can be avoided, and the practice is much to be condemned. In some cases, when a road is laid on wet, boggy ground, a layer of fascines is laid first to form a firm foundation, and then the road is formed on it; but unless the nature of the ground is such as will always insure the fascines being kept in a wet or damp state they will soon rot and the road will go to pieces. Therefore they should never be used unless under unavoidable circumstances. In some districts the foundation is formed of chalk, but this should not be used unless it can be thoroughly protected from the action of wet and frost, owing to its power of absorbing water, which causes it to turn into mud in wet weather and to blow up in frost. Stiff clay is a bad foundation owing to its great contraction in dry weather and expansion in wet. When the foundation is laid, whatever course may be adopted, the metalling, if more than 4 inches or 5 inches in thickness, should be laid in two layers, each rolled separately, if rolled, as is frequently the case, with a heavy roller only. When two rollers can be used, one light and one heavy, the better course will be to roll it all in one layer, passing the light roller over first and finishing with the heavy one. The top layer, when partly consolidated by rolling, should have a binding material laid over the surface and rolled in with the metaling to form a compact mass, and while this is being rolled it should be well watered. It is better in making a new road to roll the surface, although the metaling is left in many places to consolidate by the traffic; but in such a case a great deal of material is wasted by grinding and crushing, besides causing great inconvenience to the traffic, and the metaling also wears round and takes a long time to set. Rolling is only necessary in the case of new roads, or when a thick coat of metalling is laid. When a thin coat is rolled the roller generally smashes a great deal of the stone, which would not be the case if it were consolidated by the traffic. Steam rolling is better and more economical than horse-rolling, as it more thoroughly and quickly consolidates the metaling. With a heavily weighted horseroller the stones are much displaced by the horses' feet, in consequence of the great exertion necessary to draw it. Horse rollers are very unwieldy in use and are

now seldom used anywhere. When rolling is resorted to in repairing a road it is sometimes necessary to stock the surface of it. This should not be more than half an inch deep, as deeper than that displaces the old metaling and increases the cost, with no corresponding advantage.

The metaling should be carefully spread and of a uniform thickness and the binding material applied when about half rolled. The binding is very often applied too soon and in too great a quantity, the consequence being that the road is soft and muddy and does not get firm until the superfluous small stuff is squeezed out and removed in the form of mud or dust by continued scraping and sweeping. The proper quantity of binding material which it is necessary to use is, in my opinion, as little as possible. Clean sharp sand or fine gravel is generally used as a binding material, but, as nearly all stone where rolling is resorted to is broken by machinery, I think the screenings from that are much the best material for such a purpose, and, being of the same nature as the metaling, will unite with it and form a hard, close surface, much better than with sand or gravel, which are of a foreign nature and, not being angular, like the screenings, will not set so readily. With a silicious material limestone screenings will cause it to set better than anything else. In all cases the screenings should be of the same material as the road metal. When using a binding material the fact is too often lost sight of that it is only intended to fill up the interstices between the larger stones, and when more than sufficient for this purpose is used the bad effects before mentioned always ensue. There is no economy in repairing a road with thick coats, and rolling, unless the traffic is very considerable, although there is a great deal more comfort to the public, owing to the easier draft; there will, moreover, be much less wear and tear of vehicles. A weak road should not be rolled, as although the weight of a 15-ton steam roller is very evenly distributed over the surface and the weight is not great per inch of width, it would be likely to be very injurious to the road, owing to causes which will be mentioned further on. When once a road is coated and rolled it is too often the case that it is left to take care of itself, except for scraping and sweeping, until it requires coating again. For some time before this is done the surface is covered with depressions, which are frequently of such a depth as to be dangerous. The coating would generally last much longer if, as soon as any hollow made its appearance, it were filled up with small-sized metaling. A proper system of repairing by small patches will in all cases result in a great saving.

One of the great causes of slacks or hollows appearing in the surface of a newly-rolled road is that the metalling has not been uniformly spread. When they appear during rolling they should be filled with metalling broken to a rather smaller gauge than the rest. The road should be carefully watched after the rolling is completed, and, if any hollows should appear then, they should be immediately covered with small patches of stone. Stone for patching should always be broken to a rather smaller gauge than for coating. Too great stress can hardly be laid on repairs by patching—a matter very imperfectly understood by a great many highway surveyors and in some towns never practised at all. Roads and streets have come under my notice where little or nothing is done to them until they require coating, and so coat after coat has been laid until the top metalling is 12 to 15 inches thick on roads with only light traffic. By this means the roads have been so raised that they are in the centre considerably above the level of the sidewalks and have a sharp and frequently dangerous fall toward the sides. The materials used for road metaling must of necessity vary very much according to locality. Owing to the cost of haulage local stone must generally be used, especially if the traffic be only moderate. If, however, the traffic is heavy, it will sometimes be found better and more economical to obtain a superior material, even at a higher cost; and, in cases where the traffic is very great, the best material that can be obtained is the most economical. In some cases the better material may be used on those parts of the road where the traffic is greatest, and, in other cases, in the centre of the road only. A good road metal should be hard and tough, and if it has a certain amount of binding nature in it so much the

better. It should also be able to withstand the influences of the weather. These qualities are seldom found together, as igneous and silicious rocks, although frequently hard and tough, do not consolidate so well nor so quickly as limestone, owing to the sandy detritus formed by the two first having no cohesion, whilst the limestone has a detritus which acts like mortar in binding the stones together

A stone of a good binding nature will frequently wear much better than one without, although it is not so hard. A limestone road of good cross-section will be more impervious to wet than any other, owing to this cause, and will not disintegrate so soon in dry weather, owing partly to this and partly to the well-known quality which all limestone has of absorbing moisture from the atmosphere. The limestones are generally not hard enough for roads with very heavy traffic, where hardness and toughness are of more consequence than any other properties. For such roads the best materials are some of the granites, such as Guernsey, Penmænmawr, and Cornish; Clee Hill stones, traps, basalts, whinstones, and some of the silicious rocks. For roads of moderate traffic the best are the harder limestones and a hard sandstone sometimes found in the coal measures. Iron and copper slag are sometimes used, but, although very hard and tough, have no binding property at all, and the edges of the pieces when broken are so sharp as to cut horses' feet very badly. In some parts gravel is used very largely for road metal. It should be well sifted from small material and the large stones broken down to the proper gauge. Field stone and river stone are much used in some districts, but generally make a rough road, as they are composed of the hardest parts of those stones which have resisted the action of the weather, and are, though frequently very hard, of unequal hardness, so that they wear very irregularly. Mere hardness without toughness is not of much use, as a stone may be very hard but so brittle as to be crushed to powder under a heavy load, when a stone not so hard, but having a greater degree of toughness, will be uninjured. The size to which surface metaling is generally broken is such that a stone in its largest dimensions will pass easily through a ring either of 2½ or 2¼ inches diameter. For roads where the traffic is light it may advantageously be broken smaller, as it will then cover a larger space, consolidate much more quickly, and make a smoother surface. When the material is rolled it need not be broken quite so small, as when it is set at once by rolling it is an advantage to have a rather larger stone, as it makes a stronger road.

Great care should be taken in the preparation of the material, so that the stones shall not be long, flat, or flaky; the small stuff should not be screened from it when hand-broken, as there is generally no more than what is useful. All clay and dirt should be separated from it, except in the case of gravel, when a certain proportion is necessary, for if gravel is too clean it will not set for a long time, owing to there being so many round stones in it. The stones should, within certain limits, be kept as nearly as possible of a uniform size and a cubical form, as they then make a better and more even road. Stone broken by hand is preferable to that broken by machinery, as machine-broken stone is not so durable as hand-broken. When broken by a machine it is always crushed to a certain extent by the jaws, and therefore does not wear so well, especially under heavy traffic; but when a machine can be kept in constant use it is often cheaper, especially if the stone is very hard; with some hard stone the cost will often be found to be only about half that of hand-breaking. A hard stone which is not tough and some of the softer stones will be crushed to powder by a machine. Machine-broken stone is also frequently very flaky, which is a great disadvantage in setting. In stone broken to a gauge of 2¼ inches the proportion of solid is 55 per cent. to 45 per cent. of void; therefore, taking the average weight of a cubic foot of solid limestone to be 170 pounds, the weight of a cubic yard of broken metaling would be 1 ton 2 hundredweight 2 quarters 4 pounds. This, when consolidated, would weigh nearly as heavy as the solid stone; in fact, a cubic foot of consolidated road metal weighs on an average of from 93 to 95 per cent. of an equal bulk of solid stone; therefore, it takes 1½ of broken material to form 1 of road, or, in other words, when the metaling is consolidated it occupies two-thirds of the space

it did before. The interstices in the road coating are filled with small stones and mud; these form a great portion of all roads. In a consolidated road the amount of metaling over seven-eighths of an inch varies from 20 to 55 per cent., and the mud from 20 to 25 per cent.; the remainder consists of small stone which is very useful in the road. In a road freshly coated, of course the proportion of large stone would be greater.

Generally speaking, the road which contains the greatest quantity of large stone will be the best; but sometimes such a road, from having an ill-drained foundation, will be very weak, and large quantities of stone may be put down without materially strengthening it, and the stones will always work about in wet weather. An excess of mud should not be allowed to accumulate, as few things tend to weaken a road so much; any road containing more than is absolutely needful should be constantly scraped until it is reduced to the proper quantity. The chief causes of wear on roads are the action of the traffic and the action of the weather. The relative wear of each can not be accurately told, as the one helps the other so much, and they vary according to local circumstances. On a strong consolidated road the greatest wear arises from the action of the horses' feet and the wheels of vehicles, and the smoother the road is the less the wear will be, as in a rough road, in addition to the downward pressure, there will be that pressure on every projecting stone which will tend to push it forward, and so cause a grinding movement between the stones. This pressure is greater in proportion as the diameter of the wheel is smaller, and is much more destructive than the vertical pressure. When the material is not thoroughly set this grinding movement is still more destructive and causes great wear and waste of material. On weak or ill-drained roads great wear is caused by bending and cross-breaking. When this takes place there is a yielding of the subsoil, as well as of the road coating; the road bulges and cracks under the weight of the load, the metaling is driven into the subsoil at the point of contact with the wheel, and that surrounding it rises above the level of the road; the surface water finds its way in through the cracks and weakens the road still more, and in frosty weather the frost gets in, and when the thaw comes the road is blown up in a great many places, and wet boggy places are formed which are very dangerous. Besides this the draft is very much increased on such a road, owing to the surface bulging before the wheels, and a horse is therefore, on a level road, continually pulling the road uphill. Along the sides of the ruts may be seen cracks, which lead directly to the subsoil. The wear caused by the wheels of vehicles is influenced very much both by their diameter and width. It has been said by some that the resistance to traction on a road is in inverse proportion to the square root of the diameter of the wheel. Others say it varies inversely as the diameter.

From experiments made with Easton and Anderson's horse dynamometer at the Royal Agricultural Show, 1874, a slightly greater ratio than inversely as the diameter was given, and I am inclined to think that inversely as the diameter is the more correct view of the two. There can, however, be no possible doubt but that large wheels are much more favorable both to draft and wear of the road than small ones. The draft is always much less on a smooth, hard, unyielding road; a flexible, yielding road, although it may be elastic, will not give back the force expended in the pressure of a wheel on it, and this force must naturally be more on a yielding than on a hard road. Of the width of a wheel, it may be said that up to a certain limit a broad wheel with the same load is less destructive to a road than a narrow one in about the following proportion—not, I believe, as is generally thought, in the direct ratio of its width. In practice, I think, a wheel 2 inches wide will be found to be nearly one and a half times as favorable to the road as a wheel 1 inch wide, a wheel 3 inches wide nearly twice as favorable, and a wheel 4 inches wide two to two and a half times as favorable. This will vary more or less under different circumstances, but will be found, I believe to be about the correct proportions. My reasons for so thinking will be found in the theory explained in the next paragraph. Practically, no advantage is gained by having wheels more than 4½ inches wide. Sir J.

Macadam said that the maximum load which should be allowed on any vehicle should be 9 hundredweight per inch of width of tire; Telford and Sir J. Macneil contended that 5 hundredweight was the greatest load that should be allowed, and I think their view is the more correct one, as few roads, except in large towns, are strong enough to bear such heavy loads as 9 hundredweight per inch continually passing over them. Broad wheels loaded in the same proportion as narrow ones are much more destructive than narrow ones. A road which will bear a considerable load on narrow tires will sometimes break down under the weight of a traction engine, although the pressure per inch of width of tire may be much less. I think the explanation of this may be found in the following theory: If we take a wheel 1 inch wide, and suppose that at the point of contact with the road surface (which we will suppose for the sake of illustration consists of spheres 1 inch in diameter) it presses on a sphere and that sphere on four others, and so on in a pyramidal form, it will be found that the weight is distributed over a much larger area of the subsoil than the surface it comes in contact with. Now take a wheel 4 inches in width, and suppose it rests on four spheres placed in a row, each 1 inch in diameter, it will be evident that each sphere can not rest on four independent spheres, and each pyramid will, therefore, be composed of parts of other pyramids, which intersect each other. With a 1-inch wheel, the sphere would rest on four others immediately supporting it, and the four spheres in a row under the 4-inch wheel would rest on ten; at the same depth four separate 1-inch wheels would rest on sixteen spheres, as against the ten supporting the one 4-inch wheel, and the lower we go the greater becomes the proportion in favor of the 1-inch wheels. Therefore, the greater the width of the wheel, loaded in the same proportion, the greater will be the pressure on the subsoil immediately under it, as the load is always borne by the subsoil and not by the road coating, which is merely a hard surface formed to protect the subsoil from the immediate effects of the traffic. Of course, this will be greatly modified in practice, owing to the different sizes and shapes and nature of the actual road coating.

It may, therefore, I think, be laid down that broad wheels with the same load are much less destructive than narrow ones, but broad wheels loaded in the same proportion per inch of width as narrow ones are much more destructive. The best shape for a wheel is cylindrical; dished wheels should never be used, as, owing to their shape, their line of direction is not the same as the line of draft, consequently a lateral motion is caused, which is a source of great injury to the surface of the road, especially in dry weather, and they also increase the draft. Wheels with tires the section of which is the segment of a circle are also to be condemned. In fact, all wheels which are not cylindrical have disadvantages for which they have no proportionate compensation. The effect of springs is more noticeable with vehicles going at a high rate of speed than when at a walking pace—in fact, when walking, the draft is very little less than without springs; at higher rates of speed the draft is much less. This applies to a smooth, hard road; on a soft, yielding surface the good effect of springs is considerably lessened. The weather has a considerable effect on the wear of roads, not so much directly as indirectly, by increasing the wear caused by the traffic. Excessive wet causes great wear by softening the binding in the road coating, which destroys the solidity of it and causes great wear by the material rubbing together, and makes it less able to support the traffic. Frost after wet causes great injury. The water in the road, and sometimes in the material itself, when frozen, bursts the road coating, especially if the foundation is wet, and when a thaw comes the road becomes rotten, and much damage is sometimes caused by heavy traffic coming on a road at such a time. Rain after a thaw also causes great injury, and when alternations of frost and thaw occur the road is tried very much; indeed, a good road will sometimes break up under such conditions. If the foundation is wet, and the frost reaches through to it, the road will be blown up from the bottom. Excessively dry weather causes great wear, especially with a siliceous road material, by the small stuff and mud being loosened; but this can always be counteracted by watering.

Dry weather has less effect on limestone than on any other road material. Trees and high hedges are also a great cause of wear by keeping the sun away, the road remaining wet where otherwise it would be dry. Wear is less, generally, in proportion as a road is smooth, strong, and well drained, and of a sufficient width to accommodate the traffic freely.

Many experiments have been made to measure the wear on roads; but this can only approximately be done, unless the area and quantity of material periodically laid are known. Some say that the wear increases in direct proportion to the traffic, others that it increases in a greater ratio; but from personal observation I think that, on a road where the traffic is very heavy, the latter idea is frequently correct. The amount of material expended annually in this country on main roads varies from about 40 cubic yards per mile in remote country districts to 1,000, and sometimes 1,500 cubic yards in the vicinity of large towns; but I think the general average would be from 70 to 80 cubic yards per mile. On district and parish roads it is frequently as low as 10 cubic yards per mile. A great mistake is often made in country districts where there is little traffic in procuring a very hard stone from a distance, when a moderately hard one can be obtained in the immediate neighborhood, and at a very much less cost. The hardest stone is not always the best for a road; it is only the best when the traffic is great. On a road where there is only light traffic a softer stone is much to be preferred, because the hard stones do not consolidate under the traffic, and the road is always rough and uneven. I have seen this in many cases, to make the matter worse, where a quantity of road scrapings was put on in the spring to make the stones set. When the wet weather came this was all squeezed out as mud and had to be scraped off again, causing great inconvenience to the traffic and costing altogether about twice as much as the local stone would have done. Where roads are repaired by thin coats without rolling, as all country roads must be, on account of the small quantity of stone used per mile, great care is necessary that none of the material is wasted. When the material is laid in the proper season—viz, in the late autumn or early winter, it soon consolidates under the traffic and forms a smooth surface. All the stone should be laid before Christmas except a small quantity which should be kept for the necessary patching in the spring. The coat should never be more than one stone thick; if it is necessary to put a greater thickness one coat should be laid and, when nearly consolidated, another should be laid on the top; by this means a much firmer and harder road is formed, and with less waste of material; but, when it can be avoided, a road should never be left to get so much out of shape as to require a greater thickness of metalling than one stone thick.

Before coating a road is commenced in the autumn all the small hollows should be patched, which will prevent them wearing larger; then those portions of the road which require coating should be done. It is always best to lay the coatings in short pieces, as if a long length is laid the traffic goes to the side of the road to escape the stones, and frequently cuts it up very much, whereas when laid in short lengths it is not worth while to go to the side to do so, as they are so soon passed over; if a long length of road requires coating it should be done in that way, and when the short coatings are worn in, which will not take long in the winter, intermediate coats may be laid. When the metalling is laid it should be constantly attended to, and raked so as to prevent the formation of ruts. Generally speaking, there is no advantage in stocking a road when repaired in this way; it may sometimes be necessary to do so slightly when the metalling is laid in a dry season, but this will always depend on circumstances. Ruts are best repaired by filling in the wheel tracks first, and when the material is partly set the center rut should be attended to; this is better than doing all three at once, or the center and one side first, as in the former instance intermediate ruts are soon formed by the traffic avoiding the loose stones, and in the latter the traffic all goes to one side, whereas if the two outside ruts are filled in first, the traffic keeps to the usual line on account of having the horse pad clear, and when it is time to repair this rut the traffic soon wears the single line of stones in. If it should be necessary to lay a large coating on a street or road with heavy traffic, a

binding material may be advantageously used, but, as a rule, a firmer road is formed without it. It is essential that the superfluous mud be removed from a road. This may be done by sweeping or scraping where it is in the form of either mud or dust. When dust is regularly removed from a road it does not require nearly so much watering in dry weather as it otherwise would; care must be taken, however, in a road composed of silicious materials that the road is not damaged by too much sweeping, as it will tend to disintegrate the surface, and a great deal of useful material is liable to be swept away. The best time for sweeping is early in the morning before the dew has dried, and there is much less inconvenience to the traffic at that time. Machines drawn by horses are sometimes used to sweep up mud or dust. The most common form is a circular revolving brush, mounted obliquely, which sweeps the mud or dust in a line on the one side, to be afterwards gathered up. Another machine often used is a scraping machine, constructed in an oblique manner also, and which acts in a similar fashion. This is very useful when the mud is partly dry. The most useful machine that I have seen is Warren's. In this machine a series of brushes attached to an endless chain revolves as it is drawn along, and sweeps the mud up an inclined plane into a mud cart, to which it is attached. When this cart is full it can be removed and hauled away, and an empty cart attached, so that the machine is kept constantly at work.

Some surveyors object to this machine on the ground that it removes too much of the useful small material, about the size of small shot, from the road. It does do so to a certain extent, but this can be reduced to a minimum by adjusting the pressure of the brushes, which is easily done by simply turning a small wheel; but the amount of small stuff that this machine removes is so little more than the ordinary kinds do, that it is much more than compensated for by the great saving in time and labor, besides more effectually cleansing the road. The great advantage of this machine is that it removes the mud quickly and at once from the road, and does not interfere with the traffic while doing so. These machines can only be advantageously used in or near towns, and where there is great traffic. In the country, hand scrapers and brooms are mostly used, but a small scraping machine which can be used by one man is of great advantage. The best way to use it is from side to side, as this tends to preserve the cross-section of the road. A man can scrape a great deal more in a day with one of these machines than with a hand scraper, and do the work much better. It is said by some to be very injurious to remove mud from a road when it is at all dry, but in most cases it is better for the road that it should be removed. A road should never be watered unless it really needs it, as too much water is very injurious and it increases the wear from traffic. To insure the constant attention that a road always requires, it should be divided into lengths, each under the charge of a constant laborer. As much should be given to each man as will keep him constantly employed during the summer, and he will be able to do all the necessary work at other times with the assistance of casual laborers. The length of road apportioned to each man will, of course, vary much according to circumstances; on main roads from 1 to 2 miles on a road with heavy traffic, to 6 and in some case 8 or 9 miles on roads with light traffic. On parish roads these lengths may in some cases be longer. The constant laborer should be on his road at all times, wet or dry, and it is of great importance that he should be there during heavy rain and storms so as to see that all drains and water courses are clear, as great damage is frequently done to a road by their being choked, particularly in hilly districts, where a great amount of rubbish is usually brought down at the commencement of a storm. The constant laborer should have entire charge of his length, under the surveyor. He should not have his work set by the piece, as piecework is seldom so well done as daywork, and he should not be moved from his length to another without good cause, as nothing causes a man to lose interest in his work so much as removing him when he has succeeded in getting his length into fair order. Some men can never be made good roadmen, while others acquire the necessary knowledge and skill very quickly, and will do more work and

make the material go farther than others who have been at similar work for many years.

It is generally much better to employ such men as these, even if paid a little more money, as it will be far more economical than employing the first man who applies for the work, as is very frequently done, because he will work for less money. This system of employing constant laborers has been in use on the South Wales County roads for the past 40 years and has been found to work very effectually; it has also been adopted in several parts of England during the past few years. I think it is a great mistake to let road repairs by contract; the work is never so efficiently done as it would be by day work, with men in charge of a skilled laborer, and when under the supervision of a surveyor. The only thing which can be advantageously let by contract is the supply of road materials, which may be supplied, ready broken, in heaps on the side of the road, or, better still, in stone depots recessed in the hedge or bank. It is better to have the material in small heaps, at short intervals, so that it can be wheeled out with a wheelbarrow, rather than have large heaps at long intervals and have to cart it where it is wanted; the men can usually make the material go farther in repairing and patching if accessible with wheelbarrows. It is best to have it supplied by the cubic yard rather than by the ton, and it should not be measured until broken and stacked. It should always be delivered by the end of the summer, as the road is less injured by the carting at that time, and the longer the stone is exposed to the action of the weather the better it is. If the repairs should be let by contract the term should not be for less than 3 years, as, if let for a shorter period than this, one man may keep the road in good repair for 1 year, and use a proper quantity of material and labor on it; the next year another man may get the contract, and do as little as he possibly can to it, just keeping it of good appearance until his contract expires, and then, as soon as wet weather comes, the road shows great signs of weakness and requires a great deal of material and labor expended on it to bring it into good order again.

I have not gone into the cost of labor or material in anything referred to in this paper, as they vary so much, even within a small radius, that such details would be of little practical value. The length of road which a surveyor can well superintend must depend to a great extent on the nature of the roads and the situation of them. It will be found more economical in all ways to have districts of such a size that a sufficient sum may be paid to a surveyor as will enable the authority to obtain a competent man and allow him to keep a horse. In this case he could look after a much greater length of roads if he had two or three assistants and a uniform system of maintenance over a larger area is much to be preferred to small divisions. Extraordinary traffic, as defined by the highways and locomotives (amendment) act, 1878, has caused a great deal of trouble and annoyance. It is frequently very difficult to tell what extraordinary traffic is, and when it commences. It is much to be wished that some clearer definition of what constitutes extraordinary traffic had been given in the act and that due notice of such traffic had been made compulsory, unless the traffic should be thrown on the road unexpectedly through an emergency. Such notice can not be reasonably expected until extraordinary traffic is more clearly defined. Extraordinary traffic thrown suddenly on a road, which is amply strong enough for the ordinary traffic of the district, will frequently destroy the surface of the road, often plowing down into the subsoil and cutting the road completely to pieces. In many cases, if due notice had been given of the intended increase in the traffic the road might have been strengthened so as to have borne it with little or no injury, and at a very much less cost than the after repairs which were required to bring it into good order. I think the abolition of turnpike trusts in England and North Wales was a great mistake, until some better method had been found to obtain funds for road maintenance. Then everyone who used the road had to pay for it, but now the burden falls almost altogether upon one class, viz, the farmers, especially in agricultural districts. From inquiries which I have made in South Wales (where turnpikes still

exist) at gates close to large towns, eleven-twelfths of the traffic which passes through them comes from the towns, and even at country gates, 6 or 8 miles from any town, three-fourths come from the towns.

It is manifestly unfair, then, that the county ratepayers should have to pay the whole amount for the maintenance of roads which are much more used by the townspeople than by themselves, and to this cause, I think, may be attributed the dissatisfaction which exists in the country as to the highways and locomotives (amendment) act, 1878. These remarks are intended to apply to main roads only, and not to district or parish roads. The inferior state of a great part of the main roads may also, I believe, be traced to the same cause. The greater part of most highway district boards is generally composed of farmers, and they naturally try to reduce the expenditure on the roads to as little as possible, and in many cases have done so to too great an extent, and the roads have suffered in consequence. The tendency is also to divide the present highway districts, which in many cases are already too small, and place each division in charge of a man who knows nothing whatever about road work, the salary offered being so small that no competent man could accept the appointment, a great many highway surveyors at present having had no previous training in road work whatever. I think this is a great argument in favor of the county government of roads. The districts should be of a large size, and the surveyors should be appointed by the county authority, and be required to devote the whole of their time to their duties. District boards would be required to regulate the expenditure, and I think it advisable that all main roads should be either under separate management, as in South Wales, or be inspected by an officer appointed by the county authority; or several authorities might combine to pay an inspector, and he should deliver an annual report on the state of the roads, and superintend the preparation of the estimates. Under the South Wales turnpike act, the main roads of each county are governed by a county roads board, with, in some counties, district roads boards, as distinct from highway district boards, to regulate the expenditure. The surveyors have charge of the main roads only. The highway district surveyors are also appointed by the county roads boards, although not paid by them, and they have charge of the district and parish roads. Until recently, the main roads were annually inspected by a general superintendent of roads for South Wales, appointed and paid by the local government board. This office has recently been abolished, as the loans advanced by government to the respective county roads boards when the act was passed, have been repaid.

In many of the English counties the main roads are inspected; but in many cases it is either by magistrates, county surveyors (who are usually architects), or police superintendents, etc. These may know very well when a road is in good or bad condition; but they can not know, unless they have had special training, what is the most economical and best way of repairing a good road and maintaining its efficiency, or of repairing and making good a bad one. A great deal has been said lately as to how funds should be obtained for the maintenance of roads if the present system of rating should be abolished. In my opinion, the fairest way would be by the appropriation of the carriage tax, and if that did not prove sufficient, by the reimposition of the horse-tax. All vehicles and horses, whatever they may be kept and used for, should be taxed. In the case of vehicles, the tax should be adjusted on the basis of the tolls which were levied under the turnpike act, due regard being paid to the size and shape of the wheels. It may be said that in this case the townspeople would have to pay towards maintaining the country roads, whilst the country people would not pay anything towards the maintenance of the town roads and streets; but I think this objection may be met by providing that the tax should be divided proportionately and applied to both purposes, certain of the streets for this purpose being classified as main roads. Since the preceding paper was written, now nearly 5 years since, the local government act, 1888, has been passed, and in clause 20 it provides that all local taxation licenses, as specified in the first schedule to the act, are to be paid into the Bank of England to an account called the local taxation account, after

which, when the respective amount collected in each county has been ascertained and certified by the commissioners of inland revenue, it is to be paid, under the direction of the local government board, out of the local taxation account, to the county counsel of each county.

This schedule, in addition to others, includes licenses for carriages, trade carts, locomotives, horses and mules, and horse-dealers; and in section 121 a temporary provision is made by which, in addition to part of the probate duties, all duties on these licenses under any act of the present session are to be applied as a grant, to be distributed as follows: "In paying to every county, highway, and other local authority, who have heretofore received out of moneys provided by parliament a contribution to the cost of roads, or to the successors of such authority, sums calculated in like manner and according to the like scale and regulations as in the financial year ending on the 31st day of March, 1888." A great outcry has been made against the projected wheel-tax (withdrawn since this paper was read); but it was only to be expected, as people who have previously benefited by the taxation of others do not care to have the burden thrown directly on their own shoulders. The usual argument against it is that the roads are for the indirect benefit of all. This is quite true; and, therefore, all the more reason why some more equitable mode of obtaining funds should be provided than at present exists, by which the whole cost of maintaining the county main roads is thrown chiefly on the agricultural classes. I strongly hold that those who obtain a direct benefit from the use of the roads should pay directly towards the cost of their maintenance. At present it is difficult to judge how the act will work in relation to main roads. In South Wales, all tolls will be abolished from the date it comes into operation, and funds for their maintenance will be obtained in a similar manner as in England and North Wales. The general opinion in South Wales is that under section 11, clause 2, the various urban authorities will take possession of the various lengths of road within their districts, thus leaving many short isolated lengths, which will be transferred by the county councils to the various highway districts under clause 4 of the same section. The proper maintenance of all these roads will be supervised by the road surveyors of the councils of the different counties, and all payments to the bodies who have taken over these roads will be made on their certificates. It seems probable that the district roads there, which stand on a somewhat similar footing to the main roads in England, and receive a contribution from the common fund of the county, will all be declared main roads under the act. No special provision has been made to meet this as far as I can see, but it seems to be the evident intention of the act. In England a similar course seems likely to be taken as regards the absorption by urban authorities of main roads in their districts. The proper supervision of the main roads seems well provided for by the act, as by clause 5, section 11, no county council has power to make any payment to a district council in respect of the maintenance, repair, or improvement of any road by an urban authority until the county council is satisfied by the report of their surveyor or such other person as they may appoint for the purpose. While the more efficient control and maintenance of the main roads appear to be well provided for, the importance of the proper maintenance of district and parish roads should not be lost sight of.

MANCHESTER DISTRICT.

BLACKBURN, BOLTON, SALFORD, AND STRETFORD.

REPORT BY CONSUL GRINNELL, OF MANCHESTER.

I inclose herewith three interesting reports received from the borough surveyors of Blackburn, Bolton, and Salford, in this consular district, in reply to my inquiries as to the making and maintenance of city streets within their municipalities. I would draw especial attention to the excellent report, with inclosures, furnished me by Mr. J. B. McCallum, the borough and water engineer of Blackburn. I also inclose a report received from the surveyor to the Stretford local board.

I have delayed the sending forward of these reports in the hope of being able to obtain similar information from the borough surveyors of Manchester, Oldham, and Lancaster, but I regret to say that these gentlemen have not seen fit to reply to my letters of inquiry.

WILLIAM F. GRINNELL,
Consul.

UNITED STATES CONSULATE,
Manchester, June 18, 1891.

BLACKBURN.

Borough and Water Engineer McCallum to Consul Grinnell.

BOROUGH AND WATER ENGINEER'S DEPARTMENT,
Municipal Offices, Blackburn.

WILLIAM F. GRINNELL, Esq.,
United States Consul, Manchester:

SIR: In reply to your letter, I beg to hand you the following information which I trust may be of some use:

(1) The methods employed in making and maintaining the city streets.

After due notice has been given owners of property (see copy, inclosure No. 1), new streets are made by the corporation and the cost charged to owners of the property abutting on same, according to length of frontage. Materials are purchased by the corporation under annual contracts, and labor is done by contract, prices being arranged for each street separately. When completed, the streets are maintained by and at the expense of the corporation, both under annual contracts and by day labor.

(2) The details of the systems followed and expenses incurred by that branch of the city government having in charge the city streets.

Granite sets, 5 inches deep, with tar joints on a bed of cement concrete 6 inches thick, costing 11*s.* 6*d.* per square yard.

Granite sets, 5 inches deep, with tar joints, on hand-pitched under-bedding stone, 12 inches thick after being rolled with a 15-ton steam roller, costing 8*s.* per square yard.

Local stone sets, 6 inches deep, with tar joints, on hand-pitched under bedding stone, 12 inches thick after being rolled with a 15-ton steam roller, costing 6*s.* per square yard.

Local stone sets (seconds), with tar joints on 10 inches of clinkers and mill ashes, costing 5*s.* 6*d.* per square yard.

Granite hand broken to pass a 2-inch ring, on hand-pitched underbedding stone, 12 inches thick after being rolled with a 15-ton steam roller, costing 4*s*. per square yard.

Limestone, ditto, costing 3*s*. per square yard.

Footways: Granite curbs, 12 inches wide and 7 inches deep, with local flags 3 inches thick, mortar joints, and gravel underbedding 3 inches thick, costing 7*s*. 3*d*. per square yard.

Local stone curbs, ditto, costing 5*s*. 9*d*. per square yard.

(Specifications for materials and labor inclosed. Inclosure No. 2, Forms Nos. 1, 2, 3, 5, 6, 7, 8, 29, 33, and 34.)

(3) The materials used for streets of heavy and light traffic, respectively.

Heavy traffic streets: Granite sets on cement concrete. Granite sets on hand-pitched underbedding.

Light traffic streets: Local stone sets on hand-pitched underbedding.

Back streets: Local stone sets (seconds) on clinkers and mill ashes, run in with tar.

Macadamized roads: Granite or limestone, hand broken, on hand-pitched underbedding.

(4) The source and treatment of such materials, and the first and final cost.

Granite sets, costing 22*s*. 6*d*. per ton, and curbs, costing 4*s*. per lineal yard, are obtained from Dalbeattie, Scotland, or Newry, Ireland. (See inclosure No. 3, giving the results of experiments to ascertain the resistance to thrusting stress and the porosity of Dalbeattie gray granite.)

Granite macadam from Penmaen-Mawr, Wales, at 11*s*. 3*d*. per ton; local stone sets at 11*s*. per ton; curbs at 2*s*. 6*d*. per lineal yard; flags at 3*s*. 4*d*. per square yard, and underbedding stone at 1*s*. 8*d*. per ton, are obtained from the Rossendale Valley, Haslingden, Darwen, Blackburn, etc. About 6*d*. per ton and 3*d*. per yard is added to the above prices in order to cover office and stoneyard expenses. (See inclosure No. 4 for description of Penmaen-Mawr stone.)

(5) The cost of building and maintaining such streets, and the assessment of such first cost and maintenance.

Cost of making, 6*s*. 6*d*. to 12*s*. per square yard. Cost of maintaining, 8*d*. to 1*s*. 3*d*. per square yard.

Assessments.—First cost is paid by property owners. Streets are maintained by and at the expense of the corporation. An annual sum, amounting to about £7,000 is set apart for repairing streets, etc., and £4,500 for repairing macadam roads.

Very faithfully yours,

J. B. McCALLUM,
M. Inst. C. E., Borough and Water Engineer, Blackburn.

THE BLACKBURN IMPROVEMENT ACT, 1882.

[Inclosure No. 1, in letter of the borough surveyor of Blackburn.]

Whereas, The street called Henry street, from James street to Regent street, within the borough of Blackburn, not being a highway reparable by the inhabitants at large, is not sufficiently sewered, drained, leveled, flagged, paved, channeled, metaled, made good to the satisfaction of the corporation of Blackburn,

The corporation do therefore hereby give you notice to sewer, drain, level, pave, flag, channel, metal, and make good in the manner specified in the specification, hereunto annexed, so much of the said street, as the premises belonging to you and each of you severally and respectively front, adjoin, or abut upon, within 60 days from the service hereof:

And further, that a plan and section showing the particulars of the said works are deposited at the office of the borough surveyor, within the municipal offices, in the said borough, for inspection; and the same can be inspected between the hours of 9

o'clock in the morning and 1 o'clock in the afternoon on Saturdays, and between the hours of 9 o'clock in the morning and 6 o'clock in the evening on any other day, excepting Sunday; and the borough surveyor, upon application, will give such further information as may be needed, or you may require:

And further, that the highway and general drainage committee of the corporation will meet at the committee room in the town hall, in the said borough, on Monday, the 16th day of February, 1891, at 3 o'clock in the afternoon, for the purpose of considering any objections which may be made against the proposed level of the said street, when and where all persons interested therein or likely to be agrieved thereby may attend:

And further, that in case of your default in the premises, the corporation will, without further notice, execute the said works (except any which, at such meeting, may be ordered to be abandoned, and with such alterations, if any, as at such meeting may be ordered to be made) and charge you with the expenses thereof.

Dated this 15th day of January, 1891.

J. B. McCallum,
Borough Surveyor.

To the Blackburn school board, and William Ditchfield, clerk; to the North Britons' Friendly Society, and John Sefton Scott, their secretary; and to Thomas Brindle and Charles Augustus Sanderson, Thomas Howson, and William James Waugh, the executors of the late Thomas Ainsworth; or others, the owners or occupiers respectively of the lands abutting upon Henry street aforesaid.

Specification referred to in the foregoing notice.

To excavate the ground and form and lay a sewer or sewers along the above-mentioned street of glazed earthenware socket-jointed pipes, of the sizes and to the inclinations, depth, and length as shown on the plan and section, and connect the same to the nearest main sewer. Manholes and ventilating shafts to be constructed where shown of 9-inch brickwork in cement, with step irons built in at intervals of 1 foot; the bottoms being formed of blue radiated bricks floated in cement, and the tops arched over and covered with 6-inch landings and cast-iron lids of approved pattern.

Branch drains to be laid for all existing or future requirements as the borough surveyor may direct. Each pipe must be boned to an uniform inclination, and the joints made water tight with clay puddle or cement.

Earthenware or cast-iron gullies and grates to be fixed in the position shown on plan and connected to the sewer by 6-inch earthenware pipes. The gullies to be of the form and dimensions of the sample gullies and grates lying for inspection at the storeyard of the corporation at Islington.

The down-spouts to be connected to the sewer with 4-inch pipes; such down-spouts as require it to be lengthened for this purpose.

The carriageway of the before-mentioned street must be excavated to the depth and extent shown upon the plan and section, and a formation or underbed composed of broken stones, hard bricks, or other clean and approved material, must be broken to the satisfaction of the borough surveyor or his inspector. The underbed to be laid in the manner shown upon the section, and to be of such depth that it shall average 12 inches in thickness after being consolidated by a steam roller. The underbed to be then covered with a layer of clean, sharp, screened gravel, 2 inches in thickness, and properly prepared for the paving.

The flags, curbstones, and sets must be of good quality, and such as shall be approved by the borough surveyor.

The flags must each contain an area of not less than 5 square feet, and be at least 3 inches in thickness, well squared through, laid with close joints, in good lime mortar, on a bed of gravel not less than 3 inches in thickness.

The curbstones must be in lengths of not less than 2 feet 6 inches each, 7 to 8 inches deep, and 12 inches broad, well dressed, squared and jointed, and properly laid to the inclination shown on this section.

The carriageway of the street must be paved with what are known as 6-inch sets, squared and laid in courses of equal breadth, well and firmly bedded in the gravel. The joints between the courses not to exceed half an inch, to be well filled with clean chittings screened, when required, to free them from dirt or sand. The paving to be well rammed with proper beaters and the joints run with impervious material.

By permission of the borough surveyor, a mixture of sharp sand and clean mill ashes may be used instead of gravel when the state of the weather or the nature of the ground seems, in his opinion, to require such; and when this mixture is used it must be prepared by thoroughly blending equal parts of sand and ashes.

DALBEATTIE GRANITE.

DALBEATTIE, SCOTLAND, *February* 11, 1891.

I. B. MCCALLUM, Esq., C. E.,

Borough Engineer, Municipal Offices, Blackburn:

SIR: We regret we have kept you waiting so long for the information required, but our friend was late in replying, and, after all, his reply was not satisfactory.

We take the following extract from "Granites and our Granite Industries," by Geo. F. Harris, T. G. S., published by Crosby, Lockwood & Co., London, in 1888:

"*Dalbeattie quarries.*—The light-gray stone obtained from these quarries is fine-grained, some kinds approaching medium. The quartz is white, clear, and transparent. The feldspar is mostly white also, but here and there assumes a light-brown tint. None of the crystals are well defined, and they are much interlocked with the quartz. There is a fair proportion of black mica present, and another black mineral, which occurs in long needle-like crystals, denotes the presence, perhaps, of schorl. This last mineral is not abundant. The stone appears to be very hard, compact, and takes a beautiful polish, being highly suitable for ornamental decorations and the like."

Perhaps this, together with a copy of the crushing and porosity tests made by Kirkcaldy & Son, of London, which we inclose herein, may answer your purpose; but if not, please inform us and we will do what we can to procure further information.

Yours respectfully,

P. Pro., D. H. & J. NEWALL,
H. GILLISPIE.

Results of experiments to ascertain the resistance to thrusting stress of four 4-inch cubes of granite received from Messrs. D. H. & J. Newall.

Test No.	Name of quarry and marked.	Dimensions.	Base area.	Cracked slightly.			Crushed, steel yard dropped.		
				Stress.	Per square inch.	Per square foot.	Stress.	Per square inch.	Per square foot.
V.		*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Tons.*	*Pounds.*	*Pounds*	*Tons.*
891	Dalbeattie gray granite.	4.00×4.00×4.00	16.00	176,500	11,031	709.3	241,870	15,116	972.0
889	....do.....	3.96 4.00×4.00	16.00	174,800	10,925	702.5	240,180	15,011	965.3
888	....do.....	4.00 4.00×3.97	15.88	168,200	10,591	681.0	212,640	13,390	861.0
890	....do.....	3.97 3.98×3.98	15.84	164,900	10,410	669.4	202,230	12,767	821.0
	Mean	.....	.....	171,109	10,739	692.5	224,230	14,071	904.8

Bedded between pieces of pine $\frac{3}{8}$-inch thick.

DAVID KIRKCALDY & SON.

99 Southwark street, London, S. E., March 25, 1886.

Messrs. D. H. & J. NEWALL,

Dalbeattie Granite Works, Dalbeattie, Scotland.

Experiments to ascertain the porosity of two pieces of stone from quarry, as under.

[Weighed when thoroughly dry and weighed again after 10 days' immersion in water tank.]

Received from—	Name of quarry and marked.	Test No.	Porosity percentage of original weights.			
		V.	Before.	After.	Diff.	Porosity.
			Pounds.	*Pounds.*	*Pounds.*	
Messrs. D. H. & J. Newall..	Dalbeattie gray granite..	892	23.14	23.15	0.01	·00
		893	23.76	23.77	0.01	·00

For results of experiments under Thrushing Stress. (See report of March 25, 1886.)

99 Southwark street, London, S. E., March 8, 1888.

DAVID KIRKCALDY & SON.

Messrs. D. H. & J. NEWALL,
Dalbeattie Granite Works, Dalbeattie, Scotland.

PENMAENMAWR (WALES) STONE.

The Penmaenmawr stone possesses very slight porosity, the absorption being less than 0.03 per cent. of its weight, an important characteristic as regards disintegration by atmospheric influences, or by chemical action consequent upon contact with animal droppings or other street refuse, or by the action of frost, stones of slight porosity being best able to withstand such actions.

From Messrs. Brundritt & Co.'s quarries.

Silicia	56.25
Alumina	18.02
Peroxide of iron	3.81
Protoxide of iron	3.70
Oxide of manganese	Trace.
Lime	6.90
Magnesia	5.04
Potash	2.76
Soda	1.90
Carbonic acid	0.50
Sulphuric acid	0.03
Combined water	1.09
	100.00
Specific gravity	2.76

The crushing strength is placed at 26,837 pounds per square inch.

BOLTON.

Borough Surveyor Brockbank to Consul Grinnell.

BOROUGH SURVEYOR'S OFFICE, *Bolton.*

SIR: In reply to your letter as to street building and road making, I have pleasure in forwarding the following particulars referring to our own town:

The owner of any land desiring to open out the same for building purposes is re-

quired to provide front streets of not less than 12 yards wide and back streets of not less than 6 yards wide, which are sewered, formed, paved, flagged, etc., at the expense of the owners of the property abutting on same. In forming the roadway is excavated to a depth of 2 feet in front streets and filled in with 14 inches of ballast, back streets being excavated to a depth of 18 inches and filled in with 8 inches of ballast, and both back and front streets are paved with local grit sets of 8 inches deep. The footpaths are excavated to a depth of 6 inches and filled in with 3 inches of cinders or gravel and flagged with flags of not less than 3 inches thick in both front and back streets, the edgings and curbs being 8 inches deep and 12 inches wide in front streets and 12 inches deep and 6 inches wide in back streets.

The cost of excavating, forming, paving, etc., is as follows: Excavating, 1*s.* 6*d.* per cubic yard; 14 inch ballasting, 8*d.* per superficial yard; 8 inch ballasting, 6*d.* per superficial yard; paving, 3*s.* 2*d.* per superficial yard; flagging (front streets), 4*s.* 5*d.* per superficial yard; flagging (back streets), 3*s.* 9*d.* per superficial yard; edgings (front streets), 2*s.* 11*d.* per superficial yard; edgings (back streets), 2*s.* 3*d.* per superficial yard; curbs (front streets), 3*s.* 2*d.* per superficial yard; curbs (back streets), 2*s.* 6*d.* per superficial yard.

Public streets reparable at the expense of the corporation where there is heavy traffic are mostly paved with granite sets, and, unless the foundation is good, on a concrete bed of 6 inches deep. These sets are obtained principally from Wales and are 6 inches deep and 3 inches wide, their average life being about 30 years and the cost as follows: Concreting, paving, and asphalting 11*s.* 8*d.* per superficial yard, and will require repaving once during the time stated, at a cost of 3*s.* 6*d.* per superficial yard, making an average cost for the 30 years of 6*d.* per superficial yard per yard; paving and asphalting, 9*s.* per superficial yard, and require repaving twice at a cost of 3*s.* 6*d.* per superficial yard each time, thus giving an average for the 30 years (without concrete) of 6¼*d.* per yard per year.

Leicester Mill sets of 8 inches deep are obtained in Lancashire and will last 8 years where the traffic is heavy, the cost of concreting, paving, and asphalting being 9*s.* 2*d.* per superficial yard; they require repaving once at a cost of 2*s.* 3*d.* per superficial yard, making an average for the 8 years of 1*s.* 5*d.* per superficial yard per year. Paving and asphalting without concrete will cost 6*s.* 6*d.* per superficial yard, repaving once at a cost of 2*s.* 3*d.* per superficial yard, thus showing an average for the 8 years of 1*s.* 1*d.* per superficial yard per year.

Local grit sets of 8 inches deep, obtained from local quarries, will last 4 years with heavy traffic, and concreting, paving, and asphalting will cost 7*s.* 2*d.* per superficial yard per year; without concrete the cost will be 4*s* 6*d.* per superficial yard, or an average of 1*s.* 1½*d.* per superficial yard per year.

Yours faithfully,

W. H. BROCKBANK,
Borough Surveyor.

WILLIAM F. GRINNELL, Esq.,
United States Consul, Manchester.

SALFORD.

Borough Engineer Jacob to Consul Grinnell.

BOROUGH ENGINEER'S OFFICE,
Town Hall, Salford.

SIR: I have the honor to acknowledge receipt of your communication, and below I give you the information you require.

The "methods employed in making and maintaining the city streets," do not differ in any essential respect from the instructions contained in any of the ordinary text books on road making, but it is needless to state that the making of a street and its

maintenance, are two wholly different and distinct matters. The preparation of the foundation of a new street, to be constructed on new ground, consists of forming the ground to the same contour as that of the street when finished, and the writer can not do better than inclose one of the standard drawings which he has designed for use in his office at the Salford town hall. This section is for a new paved road, the only variation being that in localities where the traffic is very heavy, paving sets of Welsh, or other good granite are employed for the surface of the carriageway, whilst the carriageways for streets to carry lighter traffic the surface is paved with sets of somewhat larger size, of the millstone grit, which are produced principally from north Lancashire, near Stacksteads or Darwen. The life of millstone-grit sets under a fair average traffic, does not generally exceed fifteen years, whilst the paving stones of Welsh granite may be expected to stand on a good solid foundation for 25 or even 30 years. It is therefore needless to say that a high rate of carriage upon the material will be warranted where such a durable material as granite is employed.

It is of the first importance that the foundation of a street should be disturbed as little as possible either by main drainage, cross-drainage, or the laying of gas and water pipes, for foundations that have been much disturbed are pretty sure to settle more or less in process of time, causing dislocation of the sets or other surface materials, and a bad surface for traffic. The writer is of the opinion that in North America or Canada where the climate is excessive, it is desirable that all roadways should have a solid foundation of not less than 10 or 12 inches of cement concrete, laid beneath the paving sets, for even in the Manchester and Salford streets, the sets of which are laid on a layer of cinders, it is no uncommon thing to observe that during a severe frost the whole surface of a street will rise from the foundation and become detached on account of the frosts penetrating to the damp cinders under the sets and lifting them up bodily out of their place.

It would be extremely difficult to supply a reliable estimate of the cost of street-making, even in England, unless the nature of the material to be employed were specifically defined, and the locality from which it is to be obtained. The distance from which materials are procured forms an important factor in framing the estimate of cost, and a small increase in the distance from which materials have to be brought will sometimes double the cost of the work, but it may be some guide to say that 1 ton of Welsh granite se ts will cover about 3½ square yards of surface, whilst 1 ton of grit sets will cover an area of 4 square yards of carriageway. In almost every locality in or near Manchester, the footways are flagged with the best self-faced—that is, natural faced—flags of millstone grit, truly squared and laid in courses across the footway, no flag to be less in area than 3 square feet, and none more than 12 square feet in area. The curbing for the footways is of millstone grit, laid in lengths of from 2 feet 6 inches to 3 feet. The stones are 10 inches wide by 7 inches deep, laid flat.

Yours obediently,

ARTHUR JACOB, B. A., M. I., C. E.,
Borough Engineer.

WILLIAM F. GRINNELL, Esq.,
United States Consul, Manchester.

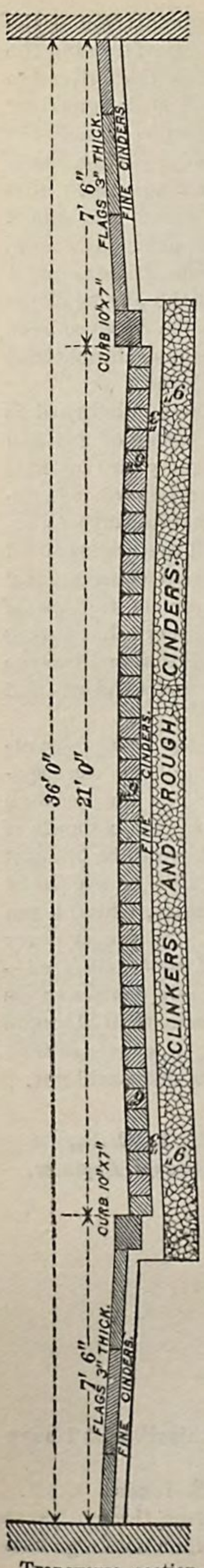
STRETFORD.

ENGINEER ROYLE TO CONSUL GRINNELL.

SIR: In answer to your inquiries respecting road-making in this district I have much pleasure in contributing the following information:

(1) The methods employed in making and maintaining the public roads.

In this local government district of Stretford which is situated on the southwest side of the city of Manchester, we have two main thoroughfares which converge at a



Transverse section of street in Salford.

point half a mile from the city boundary, through which a very large and heavy traffic of agricultural produce finds its way into the Manchester markets, as well as other general and through traffic of building material, etc., and during portions of the year the traffic continues through the night. This road is the old Roman road from London and Chester to the north. The length of this main road is 4 miles, and with the exception of half a mile the center portion, 16 feet wide, is paved with granite setts, which form the road way on which the tramcars run, the sides thereof being a macadam surface. The original way of making this road was that known as MacAdam's system, viz, by simply tipping and spreading broken stone on a moderately level surface and thus forming the roadway, the thickness of broken stone or metal varying from 3 to 6 inches. We have no broken stone roadways made on the Telford system, but I have some made by first excavating the carriageway 18 inches in depth below the side curbs. The foundation is then formed with 10 inches of cinders or furnace slag, on which is placed 4 inches of rough gravel, and the final or finished surface with 4 inches of hard stone (trap rock), broken to a 2½-inch gauge, the steam roller having been used during the making and up to the final completion. A roadway made up in this manner gives every satisfaction.

(2) The details of the systems followed and expenses incurred by that branch of the local government having in charge the public roads.

In the maintenance of MacAdam or broken-stone roads the method adopted is to use the hardest and most durable stone obtainable, and before laying on the stone the surface is hacked up with picks in cross courses about 4 inches apart in order to burst up the old material, then one, two or three stones in thickness of broken stone is laid on evenly, the steam roller being used before the gravel is put on for a binding material. The road is then watered as required and finally consolidated with the roller until completed. Two men are required to constantly brush in and spread the binding material and distribute the water until the surface is thoroughly creamed up. The rolling should be done slowly, as nothing is gained by a rapid motion, the fuel consumption being considerably increased without any advantage to the work.

Macadam or broken-stone roadways in Stretford are very expensive to maintain, in consequence of their close proximity to Manchester, and the average cost per mile for watering, scavenging, and repairing is about £360, notwithstanding the central portion, which is paved with granite, being maintained by the Manchester Carriage and Tramways Company.

The material put on the roads is from the quarries at Penmaenmawr, in North Wales, and is of the igneous or trap rock formation. It is very hard and durable, there being no better stone for the purpose. It is broken to a guage of 2½ inches (if the roller is not used it should be broken to a 2-inch gauge), and the cost per ton when broken and on the wharf is 10*s.* 3*d.*

(3) The effect of improved public roads upon land values and other economic conditions.

I can not give you any information in regard to this question,

except that there can be no doubt that good roads increase the value of land through which they pass for many purposes besides those for building, just in the same manner as main outfall sewers improve land for building purposes and the development of estates.

Yours, respectfully,

H. ROYLE,
Assoc. M. Inst. C. E.

WILLIAM F. GRINNELL, Esq.,
United States Consulate, Manchester.

TUNSTALL.

REPORT BY CONSUL BURGESS.

HIGHWAYS.

As we look into the subject of roads and road-making in this consular district we find a wide and interesting field for study. Looked at from an historic standpoint, the subject at once brings us to the time of the Romans—the world's great highway builders—at the time of the conquest by them of the islands of Britain towards the end of the first century. One at least of these old roads runs through this district.

It is not, however, from this point of view, extremely interesting though it be, that I propose to report my investigations of the very practical and important question of how roads are made and maintained within my circle of observation. The subject naturally divides itself into two heads, viz, the country roads and the city or town streets. These again subdivide themselves in the highways and country lanes; and the main roads and bye-streets.

The beautiful country roads now in use, for which these middle counties of England are so worthily famous, were, with the exception of the few roads built since 1878, made by the turnpike trusts under special acts of Parliament, the first of which was passed in 1762. The different districts of the country, having been divided into sections or divisions, each several section was placed in the hands of trustees, separate and distinct acts of Parliament being required for each of said sections. These trustees levied tolls on all traffic passing over the roads under their control; the amount of toll demanded, per horse, cart, wagon, etc., varied from time to time, according to the distance traveled between the toll gates and the amount expended in building and maintaining the roads. In some instances the trustees, finding the revenue from their roads inadequate to meet the outlay, delegated, or contracted out, to private individuals, the collection of the tolls. These individuals, having guarantied the necessary amount to the trustees and depending for their reimbursement on the tolls, looked very sharply after the just and full collection of the same.

Under these trusts many of the old lanes and wagon tracks, by the proper use and periodic application of hard broken stones (obtained from the adjoining counties) to the ruts and holes caused by continued travel, have attained a condition equal to the highways running through the country. To the good judgment and judicious care of these trusts is due the present almost perfect condition of the main or country roads of England. Many years, however, of untiring labor have been required to accomplish such results.

These trusts, however, were abolished in this district about the year 1878. From that date to the year 1888 the roads were under the control of, and maintenance of the same devolved upon, the local authorities.

At the present time the county council, who occupy in general the position of our county boards of chosen freeholders, or county commissioners, have the entire oversight and control both of the building and maintenance of the country roads. A county surveyor is appointed by them, who is a paid officer, devoting his entire time and attention to the one subject of roads, laying out and constructing new ones and keeping in repair the old, and buying all the materials necessary thereto.

The county is divided into districts and the detail of the road work is looked after by assistant surveyors.

The money required for the proper maintenance of the highways, outside the town limits, is derived by a precept issued periodically by the county commissioners to the various town authorities, demanding the amount which has been expended on the roads in their locality. This amount is collected by the town authorities in the general town rates, or taxes, the rate for this purpose now being 3 farthings on the pound, or about $\frac{3\,1}{1\,0\,0}$ of 1 per cent., and are levied on the estimated rental value of the property and paid by the occupier, be he the owner or only a leaseholder.

The cost of keeping these country roads or highways in proper order necessarily varies greatly according to the locality and according to the amount of traffic passing over them. The Stafford County council estimate the annual cost to be from $150 to $500 per mile. The road-beds are not only kept in order, but the road-sides are kept clean and free from grass and weeds. The loose stones are gathered and the mud and dust is more tenderly cared for than is the case in many of our larger towns.

STREETS.

The term main roads in this district indicates the chief streets or thoroughfares within the town limits.

The local governing bodies, be they the town council of an incorporated borough or the local governing board of an unincorporated place, have the power granted to them to maintain and repair the main roads

within their boundaries. The county surveyor, however, has an oversight of all this work, and if he certifies that the roads have been kept in proper repair the county council annually reimburse the local bodies for the expenditure they have made.

The kind of roadbed in general use in this district is that so well known by name in the United States, as the "macadam road," and yet so often disgracing the name on account of the cheap and incomplete manner of its construction. The construction of the roadbed here is very thorough, the extent of the excavation depending upon the nature of the soil. Two feet is the usual depth to which this excavation is made, but should the soil prove loose or of a nature unsatisfactory for a good foundation a still greater depth is reached. A layer of hard broken bricks or the refuse from the many potteries of this neighborhood, such as cinders, broken ware and saggars, or any other hard refuse material is put down to the depth of about 18 inches. The contour or rounded shape of the road is roughly formed in this state, the mass being consolidated by means of steam or heavy horse rollers. The former are generally used and of course are much preferred on account of their great weight, the standard weight being 12 tons. The next 3 or 4 inch layer consists of granite stone of the best and hardest quality, broken into pieces capable of passing through a 3-inch gauge. The mass is again rolled. The finishing coating of about 3 inches is of the same quality of stone, but broken to a 2-inch gauge and mixed with half-inch chippings of the same material. This being again well watered and rolled many times, produces a wonderfully hard and even surface.

The cost of this macadam stone varies according to the size to which it is broken, but would average about $2.70 per ton, delivered in the towns of this district.

The approximate cost of building a main road on which the traffic is very heavy, as is the case in all the pottery towns, is estimated at about $2.44 per superficial or square yard. The estimated annual cost for maintenance and repairs, taking 6 yards as the average width of the roadbed, is $1,296 per mile or 13 cents per superficial yard.

The by or side streets of the towns are made in much the same way as the main roads, with the exception that, on account of the traffic being much less, and so great a depth of foundation being unnecessary, only a 12-inch core of hard material is made, the final layer consisting of broken limestone, about 3 or 4 inches in thickness, rolled and watered as before.

The cost of building these by streets including the cost of paving and curbing with bricks made for the purpose is estimated at $1.80 per superficial yard. There are many of these side streets which have been laid out and built by the property owners, desirous of opening up their property, and the streets not having been turned over to, nor accepted by, the towns, their maintenance devolves upon the property owners.

Where such streets are used by the inhabitants at large, thus making them public streets, and are found to be in bad condition, the property owners are served with a notice to repair or make good the same; should they fail to do so, the town authorities step in and do it themselves, apportioning the cost to the several property owners who are compelled to pay.

The granite used in this district is obtained from the adjoining county of Shropshire and from North Wales; the limestone from Derbyshire.

The wood or Nicholson pavements have been used to a small extent in some of the towns, but do not meet with much favor. It is not solid and durable enough to suit the tastes of a people who glory in their solidity and who, when they build even a house, expect it to stand for generations.

One of the greatest charms of English scenery to the American visitor is the beauty of its hedge-lined, stone-bedded roads. Much of Englands scenery would be nothing without them. Would they not add as greatly to the natural beauties of our own country? The Rev. Dr. Cuyler, of Brooklyn, on the subject of "How to make rural life more attractive," writes as follows:

> Take the single matter of roads, for example. Most country roads are abominable for at least half of every year. They make it very difficult for farmers to drag their produce to the nearest railway or market; they make all social intercourse and travel wretchedly uncomfortable. If country people would open their eyes to this fact and open their hands and pockets to improve their highways, they would find it not only to their pleasure and comfort, but also in the end to their pecuniary profit. Good roads would be one of the first and most indispensable conditions of restoring and reinvigorating the declining country districts.

Nothing can be truer than the above. The fact presents itself strongly to me, as I see daily, the enormous loads of farm produce carted with ease along these country roads by one horse, which at this season of the year (March) in America, would require at least 4 horses, if indeed, it would be possible at all to market the produce.

It is difficult to arrive at any facts in dollars and cents relative to the effect of improved public roads upon the value of land or other economic condition, but the effect of such roads now, and for so long in existence, is seen on every hand and the influence felt in the English mode of life. Englishmen, be they of the gentry or of those in the humbler walks of life, seek their pleasure in and gladly betake themselves to their country homes. The one medium of this pleasure so natural to all men is the solid roadbed over which one can walk, or ride, or drive with equal comfort or pleasure in any day of the year.

WM. BURGESS,
Consul.

UNITED STATES CONSULATE,
Tunstall, March 28, 1891.

IRELAND.

IRISH HIGHWAYS.

REPORT BY CONSULAR AGENT MAGAHAN, OF LURGAN.

CONSTRUCTION AND MAINTENANCE.

In Ireland the construction and maintenance of the public highways throughout suburban and rural districts in each county are regulated by means of the grand-jury presentment system.

Every county is divided into baronies, and in each barony a presentment sessions court is held twice a year, the persons composing the court being the magistrates residing in or having property and jurisdiction in the barony, and a number of the resident rate-payers in the barony, the latter being nominated by the grand jury of the county at the previous county assizes.

Previous to each presentment sessions all applications for the construction of new bridges and roads or the maintenance of existing roads and bridges within the barony are lodged with the secretary of the grand jury, who classifies the applications and attends with them at the court, where they are examined and approved of or rejected.

Advertisements inviting tenders for all such works as have been approved of are then issued and a day for the consideration of the tenders is fixed (this being called the "adjourned road sessions"). The county surveyor, who is the engineer in charge of all the highways, bridges, and other public works in the county, prepares the necessary plans and specifications, and when, after an interval of 3 or 4 weeks, the court—"the adjourned road sessions"—reassembles, all tenders sent in are examined and the several contractors declared, each contractor having to enter into a bond, with sureties, for the due execution of the work.

A list of the contracts thus (provisionally) entered into, giving contractor's name and a brief description of the work, as to length, width, material, and contract price, is then printed for the information of the grand jury at the following assizes, when, if approved of, they are laid before the judge and "fiated" or finally confirmed.

The grant warrant of each assizes (of which I herewith send a copy) contains full particulars as to each contract, together with details as to the amount of tax ("county cess") to be levied on each barony for all purposes connected with roads, bridges, public buildings, salaries of officials, etc.

The grand-jury cess ranges from 8*d* to 20*d* per pound valuation of the lands and buildings in baronial subdivisions of the county. In

this way every barony supports its own roads and bridges, except mail-post roads, which are charged half on the barony and half on the county at large.

The county surveyor is assisted by six or more deputies, in proportion to the area of the county. Appeal on the part of rate-payers against the county surveyor's certificate for payment to any contractor may be made to the grand jury at the assizes, when all grounds of complaint would be inquired into, and, if necessary, to the judge.

EXPENDITURE.

The annual expenditure on the public roads and bridges in the county of Armagh (a small county) is about £22,000 per annum. The expenses are:

One county surveyor	$2,300
Four assistant surveyors, each having his own district	1,600
Secretary to the grand jury	925
County treasurer	1,600
Collector of tax (county cess), probably	5,000

The duties of the secretary of the grand jury and of the county treasurer extend over other departments of the grand-jury system, such as asylums, jails, court-houses, coroners' inquests, etc.

As the county of Armagh is fairly provided with roads, it is not easy to say what is the actual amount of depreciation in the value of land where the lands are inconveniently situated with regard to the roads. It is easy to calculate such case by comparing the actual amount of cartage to and from land per annum, compared with what the cartage would be were the land conveniently situated with respect to a good road.

ROAD MATERIALS.

The materials employed for the construction and maintenance of roads in this country are broken stones and gravel—chiefly depending upon whether the roads are in a stone or a gravel district. For roads subject to heavy traffic broken stone "metaling" is essential, laid on a pavement of stones set on edge closely together, the top interstices being filled with "spawls," so as to provide a firm foundation for the metaling. Round stones, such as are found in coarse gravel, should not be used, as they invariably yield to lateral pressure; therefore "bottoming" should be done with quarry stones or natural bowlders broken to a suitable size, so that the natural rounded surfaces are not in contact with the pavement. The strength of the road crust must be determined by the engineer according to the nature and amount of the traffic to be provided for.

In first-class roads the depth of the foundation pavement should be 12 inches and of the broken stones 8 inches. Second-class roads, foundation pavement 6 to 8 inches, and metaling 6 inches deep.

Stones for metaling should be broken sufficiently small to pass through a gauge ring 2 inches diameter. The full depth of the broken stones should not be put on in one layer, but in two or three layers, each to be fairly consolidated before the succeeding layer is laid on.

MAINTENANCE.

The future maintenance of roads will be greatly increased if strict attention is not paid to the following structural conditions:

(1) Perfect and permanent drainage of the site of the road, such as will provide in future for drainage to a lower level than that of the road foundation. Defective drainage will involve an extravagant expenditure of material for maintenance in wet weather and will require increase of power for the traction of loaded vehicles.

(2) Such fall from the center of the road to the sides, and laterally in the water tables and outside chains as will prevent the water from causing any degree of dampness to the road crust or the substratum on which the foundation rests. With regard to permanent drainage much will depend upon the selection of the line of the road as to lateral gradients, and the question of the drainage of the district.

(3) The quality of the material employed. In many cases road material (broken stone) is found to give way under the traffic in wet weather, producing mud, which increases the cost of scavenging, and renders the employment of such material ineffective, or nearly so. The hardest material within reach should be employed, even at a considerable increase of cost. Stones broken by machinery are not nearly so effective as those broken by hand, as the crushing power applied to break them shatters the natural structure.

THE COST OF ORIGINAL CONSTRUCTION.

First-class.—The cost of earthworks, hedges, and fencing are so very variable in amount that each particular case must be taken by itself, and therefore I can only speak of the cost of bottoming and metaling.

For foundation bottoming, as already specified, having the materials within a distance of 2 miles from the work, per yard superficial, 18 cents; broken stone metaling, 24 cents.

Second-class.—Foundation bottoming, per yard superficial, 10 cents; broken stone metaling, 17 cents.

Extra lead beyond 2 miles would increase the foregoing items of 1*s.* 10*d.* and 1*s.* 1½*d.* per square yard cost to the extent of 10*d.* and 6*d.* respectively for each mile of lead beyond 2 miles.

COST OF MAINTENANCE.

The cost of maintenance is, in practice, very variable, principally dependent upon the degree of perfection with which the road has been

constructed, but largely influenced by the employment of a sufficient number of surfacemen for maintaining the surface in proper condition under skilled supervision. The following particulars are taken from Sir John F. Burgoyne's treatise giving the cost of maintaining the road from Tours to Caen (France), viz:

Year.	Material.	Road labor.	Total.	Year.	Material.	Road labor.	Total.
1832	£872	£195	£1,067	1837	£584	£504	£1,088
1833	708	205	913	1838	445	456	901
1834	745	236	981	1839	412	420	832
1835	671	280	951	1840	271	392	663
1836	684	293	977	1841	163	445	608

The foregoing particulars show that by increasing the skilled labor and diminishing the consumption of material the cost of maintenance is much reduced. This practice, however, has its limits. Care must be taken that the crust of the road shall not be worn down below the thickness as originally constructed.

In the county of Armagh the prices paid per mile per annum for the maintenance of roads of the first-class are as follows:

Highest per mile per annum	$320.00
Lowest per mile per annum	80.00
Average per mile per annum	110.00

In a work on "The maintenance of macadamized roads," by Thomas Codrington, chief engineer (to be had at 446 Broome street, New York), the mean cost of the whole of the macadamized national roads of France for 1876 is given as $165 per mile. In some departments the average is given as low as $75 and $80 per mile. The same authority states that the average cost per mile of turnpike roads in England and Wales was in 1874 $155 and in 1875 $147.

The steam roller for the consolidation of the metaling of newly-coated roads is a recent economic improvement. The road metaling is consolidated at once, a smooth, firm surface is provided, and the broken stones are pressed in their original angular condition. Where the heavy roller is not used the broken stones are subject to great wear by being in a continual state of disturbance, producing mud; the angles are worn round and such compact consolidation as is produced by the roller becomes impossible, and the crust is weak and ill adapted for heavy traffic.

FRED. W. MAGAHAN,
Consular Agent.

UNITED STATES CONSULAR AGENCY,
Lurgan, February, 1891.

BELFAST.

REPORT BY CONSUL RUBY.

There are two classes of streets in Belfast, those maintained by the corporation out of the borough rates or taxes, and those maintained by owners of the property. The latter class are very few in number.

The principal officer in charge of the streets is the city surveyor, who is appointed by the corporation under local act of Parliament. In towns not having a local act he is appointed under the public health act, which is a general one. His immediate duties are those of engineer and surveyor to the corporation and the carrying out of such acts of Parliament as are in force in the city relating to streets and buildings.

The salary and those of his staff are as follows, per annum:

Surveyor	$3,645
Assistant	1,500
General assistants	2,732
Clerks	1,185
Apprentice clerks	219
Building inspector and two assistants	1,540
Outdoor superintendents	2,455

The workmen are employed by the outdoor superintendents, and the wages paid are as follows, per hour:

Bricklayers	$0.16
Stonecutters	.14
Carpenters	.15
Paviors	12 to .16

The gangers have various rates from $6.30 to $6.54 per week.

There are about 150 miles of streets in Belfast, of which about 50 miles are macadamized, ten paved with sets and ninety with sea pebbles.

The cost of repairs in 1890 was about £25,000 to the corporation.

The best paving sets come from Wales, and the present prices are as follows: Four by 4 by 4 inches, $4.36; 4 by 4 by 6 inches, $4.48 on quay in Belfast. Local granite costs about 48 cents per ton less.

The best paving is always executed by the corporation workmen and not by contract, as is usual in the case of most new streets. It is laid on a concrete bed composed of four parts clean broken stones, two parts clean broken brick, two parts clean gravel, and one part best Portland cement. This concrete is made 6, 9, or 12 inches thick, according to the nature of the ground and traffic.

Just before paving the concrete is covered with grout one-half inch thick, composed of six parts screened gravel to one part cement, and the sets are set in this.

The stones are paved close, just touching, and in perfectly straight lines.

The joints are run in with grout of five parts clean gravel to one part cement.

The concreting and paving follow closely. Concrete put in on one day is paved on on the next.

The street is then fenced off from traffic until the whole is properly set. Sometimes in bad weather 2 extra days are given, but as a rule 1 week suffices.

Asphalt is not now used for grouting. It is more costly in case of repairs than cement.

Sets from the Welsh granite company's or Port Neut quarries are always used for the best pavements.

Formerly the size was 3½ inches to 4 inches wide by 7 inches deep, but they have been found rather large to give good foothold. The sets now used are chiefly 4 by 4 by 6 inches deep. This size looks very well, and is very safe for traffic.

Granite sets and local whin stone are used here in small quantities, but they are very costly when the wear is considered, although, being cheaper at first, they tend to keep down the price of the Welsh stones.

For macadamizing whinstone is principally used. It is obtained from the surrounding farms, where it crops up out of the ground. It is broken up by the small farmers during their leisure hours or by the prisoners in the jail and is very cheap. The foundation is made of larger stones than those used on the surface and are firmly rammed in by a hand rammer. It is then coated from 4 to 6 inches deep with broken stones of a finer class. It is then traversed by a heavy steam roller which crushes the stones to a sufficient degree of fineness to make travel easy and agreeable. It is necessary to put on a fresh coat of stones about 2 inches in thickness at periods varying from 1 to 6 months, depending on the amount of travel on the streets.

Wood is not used for paving in this country, as being very expensive.

Where laying out streets in the first instance a plan and specification are lodged with surveyor or corporation by the owner of the property intending to make the street. The surveyor then approves or disapproves of the plan on account of, among other reasons, the lines, levels, width, mode of drainage, or specification proposed, and no street plan can be approved until the surveyor is satisfied.

The owner then makes the street in accordance with the documents lodged, and if he does so the street is adopted and owner is liable to keep it in repairs.

If the street laid out as above be not made by the owner when demanded by the corporation, the corporation makes an order and the owners can be sued for the cost, which is a charge against the property.

The entire cost of making streets is chargeable to the owners, but the corporation may in special cases, if they see fit, bear a share of the cost *i. e.*, a street made for special purpose or of extra width.

SAMUEL G. RUBY,
Consul.

UNITED STATES CONSULATE,
Belfast, February 23, 1891.

DUBLIN.

REPORT BY CONSUL REID.

CITY STREETS.

There are three classes of streets in Dublin, each class being constructed with reference to the principal uses to which it is likely to be subjected.

(1) *Stone pavements.*—This class of streets is constructed with special reference to heavy traffic and a great deal of driving. It includes, of course, the principal thoroughfares of the city. The method of construction is substantially as follows: The initial step is, of course, to establish the desired level, which is done by excavating or filling, as the case may be. A foundation for the pavement is then laid, consisting of a bed of concrete 6 inches in thickness, one-eighth part of which is Portland cement and seven-eighths clean gravel and sand. The surface is perfectly and uniformly even and the outline between the curbs is slightly convex, the degree of convexity being 1 inch in 36, so as to throw the water caused by rainfalls into the gutters on either side. Special pains are taken to secure a substantial and durable foundation, as the soil of Dublin as a rule is very bad. The area covered by the newer portion of Dublin, being originally only slightly above the surface of the River Liffey, which divides the city into two nearly equal parts, was very marshy, and now rests largely upon made ground. It may be said in this connection that the street foundations are never disturbed by frosts. The temperature is, of course, very mild. Only a few times during the winter season is it sufficiently severe to freeze a slight crust upon the earth's surface. A covering of 1 inch of fine gravel is then spread over the surface of the concrete for the purpose of accommodating the slight inequalities of the paving blocks.

After the foundation is completed in the manner above described and is sufficiently seasoned the stone blocks or "sets" are laid down in rows, crosswise, in the usual way, and are well rammed into place with a heavy iron-shod mall. A mixture of hot pitch and creosote oil is then poured into the interstices between the sets and the remaining space is filled with fine gravel. The pavement is then complete and ready for use.

The material used for stone pavements in Dublin is taken from the Wicklow quarries and consists of greenstone or trappean rock, a very hard and durable material. In fact the objection is made sometimes that it is too hard, as it becomes dangerously smooth in dry weather, presenting an almost glassy surface.

The size of the blocks or sets is 7 inches long, 6½ inches deep, and 3¼ inches wide. The cost of these sets delivered in Dublin is 24 shillings and 6 pence ($5.96) per ton. One ton of sets suffices to cover an area of 3 to 3½ square yards. The cost of this pavement, including everything, varies from 12 shillings ($2.92) to 14 shillings ($3.40) per

square yard, according to the amount of work done at a time and the facilities for getting rid of the excavated material.

The average durability of a pavement thus constructed and of the materials mentioned is 25 years. Of course some repairs are necessary during this period, but the extent depends largely upon how much the street is broken in laying pipes, repairing and building sewers, etc. The sets are not worn out even after being in constant use during this long period. When replaced they are generally redressed and utilized upon side streets.

The streets in Dublin thus paved are very fine and are frequently commented upon favorably, especially by American visitors. However, they are said to be inferior to the pavements of most English cities. I am informed that the character of the pavements here could be greatly improved by a more perfect dressing of the sets. Under similar conditions the sets used in many English cities cost 29*s*. ($7.06) per ton, the difference in price being made up in the more perfect dressing of the sets. The advantages of more perfect dressing are that a more even and less dangerous surface is secured, and a street over which rapidly moving vehicles make less noise.

(2) *Wood pavements.*—This class of pavement nearly corresponds to what is known as the Nicholson pavement in the United States. It is laid upon some of the strictly commercial streets, where there is only a limited amount of heavy traffic, and opposite churches, hospitals, and other institutions, and in cases where a minimum amount of noise is desirable.

The foundation for this pavement is constructed in exactly the same way and with the same materials as above described in connection with the stone pavement, except that an even more perfect surface is required upon which the wooden blocks or sets are immediately laid. The blocks are laid in rows, crosswise, quite closely together. The spaces between are partially filled, as before, with a mixture of hot pitch and creosote oil. The remaining part of the space is filled with a mixture of one part cement and six parts gravel, to further solidify the pavement and to protect the deposit of pitch and creosote oil from the action of the sun. This makes a very fine, noiseless, and fairly durable pavement, the average life of which is about 10 years.

The materials used for this kind of pavement consist of beech or Archangel deals (pine), the timber first being well seasoned. The size of the blocks is 9 inches long, 5 inches deep, and 3 inches wide. The cost, delivered, is £8 17*s*. 6*d*. ($43.18) per thousand blocks. About 50 blocks are required for each square yard. I should add that before the blocks are placed they are thoroughly creosoted under steam pressure, 10 pounds of creosote being used for each cubic foot of timber.

The cost of a pavement of this description, including construction of foundation, etc., is 14*s*. ($3.40) per square yard.

Macadamized streets.—This class of streets in the city, mainly to be

found in parts outside of the center, over which there is a limited amount of heavy traffic, is constructed in exactly the same way as the country roads, which is described in detail in a subsequent part of this report.

How paid for.—The disbursements occasioned by the construction of all streets within the city limits by the municipal corporation are made from the proceeds of a general tax upon all city property. No part of the cost of the construction of any street specially falls upon abutting property.

Population.—For the convenience of persons who may be interested in the subject-matter of this report, in estimating the probable amount of traffic and the extent to which the public thoroughfares are used, I may add that the population of Dublin, according to the last census (1881), is 249,602.

Vehicles.—Nine out of ten of the vehicles used for carrying goods and conveying people are mounted upon two wheels. As a rule the vehicles, heavy and light, are hauled by one horse only. Heavy loads, however, are hauled in this way, large and powerful horses being used for heavy traffic.

Method of doing the work.—All streets in Dublin are built by day and piece labor, under the immediate supervision of experts employed by the corporation. The wages paid for labor are as follows: Ordinary laborers 14*s.* ($3.40) to 18*s.* ($4.38) per week. Concrete men 22*s.* ($5.35) per week. Rammer men 24*s.* ($5.83) per week. For laying blocks, or sets, a rate of 2½*d.* (5 cents) per square yard is paid.

For the data upon which the foregoing part of this report is based I am indebted to the courtesy of Mr. L. J. Lawless, the assistant engineer of the city of Dublin.

COUNTRY ROADS.

The country roads in Ireland have received and are receiving very considerable attention. However, it is said that they suffer materially from comparisons with the roads in England and Wales, but as compared with the average country road in the United States they seem to approximate closely to perfection, a condition which must not be considered marvelous or even surprising when the antiquity of the country and its settlement are taken into account.

The course described by the country roads in Ireland is most irregular and even tortuous, the apparent purpose being to avoid the points of the compass. Although doubtless not so intended it may be said, in the respect mentioned, they serve to suggest the peculiar individual characteristics as well as the devious historical record of the masses of the people who travel over them. However, as a rule it may be said, at least in partial justification of the arrangement, that the main public thoroughfares in Ireland connect centers of population or interest But the geometrical proposition was unknown or unheeded when the

course of the roads was determined, viz, that a straight line describes the shortest distance between two given points. But for all this I am bound to say that the traveler who is not pressed for time, especially if he is mounted upon other legs than his own, will find greater pleasure in following the ever recurring and graceful curves of the Irish country roads, than in moving in strait lines and turning repeatedly at right angles.

But all this is scarcely even incidental to the immediate work in hand, to which I now give attention.

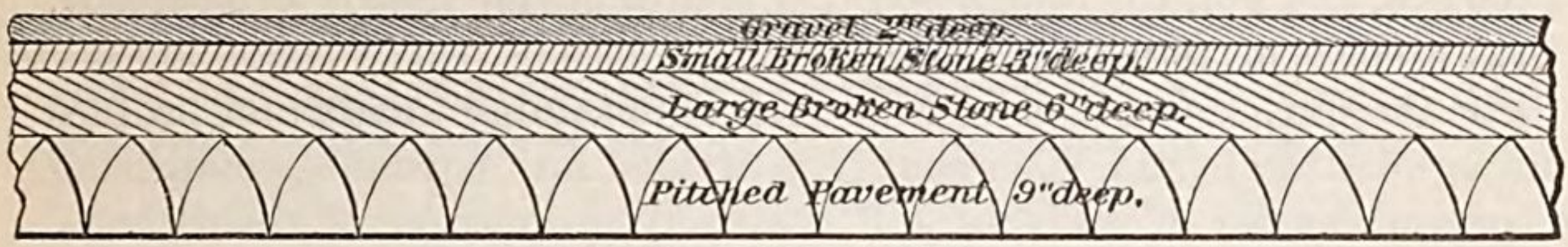
(1) The methods employed in making and maintaining the public roads:

When a new road is constructed a grade is first established generally corresponding (when the roadway is completed) with the contour of the land upon either side. Trenches are sunk on either side to a depth of about 3 feet. The excavated material is used to construct fences on either side. Into the trenches the subsoil of the road is carefully drained by means of narrow cuts, placed herring-bone fashion, filled with field stone to prevent the washing of the surface and through which the water percolates. The original surface of the roadway is then removed to a depth of about 9 inches and an artificial surface of converse section formed and the ground allowed to dry and harden for some time.

The next operation is to make what is called a pitched pavement on this surface, generally of corresponding sections, and about 9 inches in depth, which consists of rubblestone placed on edge across the axis of the roadway. The interstices are filled in with stone chipping, so as to wedge in between the rubblestone forming the pavement. The width of the roadway is never less than 16 feet, and is sometimes much more, according as the local traffic may require. On this foundation is placed broken stone to a depth of 6 inches. These stone are of uniform size, which is determined by causing them to pass through a 3-inch ring. The mass is then rolled three or four times with a roller weighing about 1 ton. Next a coating of smaller broken stone of uniform size, which are passed through a 2-inch ring, is spread upon the surface to a depth of 3 inches. The roller is then applied the same as before. A coating of clean gravel 2 inches in depth is then spread over the surface and the road is complete. The road surface curves slightly from the center towards the sides, the fall being 1 inch in 36. This degree of convexity has been found to be suitable to the requirements of traffic, and is sufficient for proper and thorough surface drainage. When opened for use it is necessary to keep the longitudinal tracks formed by traffic raked in for some time until the mass becomes consolidated.

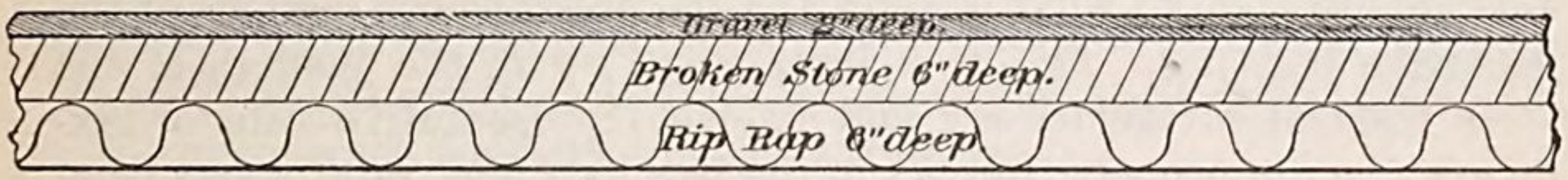
The cost of a road as above described is 2*s.* and 6*d.* (60 cents) per superficial yard, exclusive of the cost of preparing the surface, as this varies according to circumstances.

The cost of maintaining this class of rood varies from 4 to 7*d.* (8 to 14 cents) per square yard per annum.



Section of Road for heavy traffic.

The road I have described above is designed for heavy traffic. The ordinary country road is constructed in a similar way, however, except that the foundation is constructed of field or riprap stone to a depth of about six inches. Upon this is placed a stratum of broken stone, uniform in size, to a depth of 6 inches, and on this again a dressing of clean gravel of 2 inches in depth.



Section of Road for light traffic.

The cost of constructing a road as above described is 2*s.* (48 cents) per square yard. The cost of maintenance is 1 to 3*d.* (2 to 6 cents) per superficial yard per annum.

The broken stone used in road making is of the kind known as greenstone. These are almost entirely broken by hand. For this class of labor the contractors pay 3*s.* and 6*d.* (85 cents) per ton. The men earn at this rate about 2*s.* and 6*d.* (60 cents) per day.

The soil of Ireland is poorly adapted to roadways, the frequent rainfalls making it very spongy. The utmost care in drainage is, for this reason, necessary. However, the roadways suffer but little from the action of frost as it rarely ever penetrates more than two or three inches.

I may add in this connection that nearly all of the bridges in Ireland, large and small, and both in the cities and in the country, are constructed of stone, and are, therefore, very durable. There are numerous bridges of this kind in and about Dublin, over which there is a heavy traffic, that are over a century old, and which are still apparently as substantial as when built.

I find that by consulting reliable statistical authority that there was expended upon roads and bridges in Ireland, during the year 1888, £638,041, a sum equivalent to $3,977,737. It must be borne in mind in this connection that, the country being very old, but comparatively little absolutely new work is required. Hence, for the most part, this sum is expended in repairs and maintenance. The sum named represents about the average annual expenditure, the year 1888 being the leatst for which information under this head is attainable.

It may not be out of place in this connection to state that the total population of Ireland at the present time is estimated to be about 4,700,000, and that the total amount of land-rents for 1889 is £13,969,907.

(2) Details of the system followed:

For the purpose of constructing and maintaining roads and bridges throughout the island, each county is divided into baronies, comprising a certain number of parishes and a certain proportion of town lands. There are several of these baronies contained in every county. The method of proceeding is peculiar, but has been found to be effective and satisfactory. It is substantially as follows: When any new or reconstructed work or repairs are wanted, any two rate or tax payers of a barony make written application to this effect to the secretary of the grand jury for the county comprising the barony, stating the extent of the work wanted and the amount which it is desired to expend. The secretary of the grand jury prepares a schedule of all such applications and submits them to what is known as the presentment sessions of the respective baronies. This is a body made up of the justices of the peace resident of the barony and twelve representative rate or tax-payers who are property-owners in the barony. The rate payers composing in part the board are selected by the grand jury from one hundred of their class whose names are sent in by the tax collector of the barony, after the manner of drawing petit jurors in many of the States of the United States. These then serve upon the board one year only and are replaced from year to year by others of their class in the manner already described. The body thus constituted, holding annual sessions for this purpose, considers the applications presented by the secretary of the grand jury and determines, so far as it is empowered to do so, what applications shall be approved and what shall be rejected, but in no case can it extend or increase the applications. This body is governed to a considerable extent in its conclusions by the recommendations of the district surveyor, who possesses expert knowledge and practical judgment of the matters under consideration. When the work of this body is concluded the applications approved are placed in the hands of the secretary of the grand jury, who has a printed schedule thereof prepared. This schedule is laid before the grand jury of the county, which, for this purpose, meets once a year, in the county of Dublin, and in other counties twice a year, to consider presentments which come to it from the several presentment sessions. The original applications also accompany the presentments. The grand jury has the authority to approve or reject any or all presentments, but it can not alter them. Such of the presentments as are approved are submitted to a judge of the queen's bench, by whom they are fiated if approved by him. I should add here that any cess or tax payer can enter objections to any work at any stage of the proceedings before the barony board, the grand jury, or the judge of the queen's bench. If his objections are valid they will of course be duly considered.

After the presentments are fiated by the judge they are returned to the presentment sessions, which body proceeds to negotiate for contracts for the work. Acting under its authority the secretary of the grand jury advertises for tenders or proposals for each piece of work, according to the terms of the particular presentment. A condition of every proposal is that it must not exceed the amount stipulated by the grand jury for the work. If no proposal is received, or should it exceed the amount previously fixed upon, the district surveyor may be authorized by the presentment sessions to proceed with the work by day labor, but this seldom happens. Every person to whom a contract is awarded is required to furnish two satisfactory sureties. Should he at any time fail to comply with conditions of his contract, the district surveyor can, by giving him 10 days' notice, take charge of the work, the contractor and sureties being held pecuniarily liable for his failure. Nearly all country roads are constructed on the contract system. If the work is limited the contract is usually taken by a local farmer. If the work is extensive it is done by an experienced contractor. All forms of contract are drawn by the surveyor.

I should say here that if from neglect or indifference of local taxpayers applications for needed work are not filed in the usual way, the district surveyor is authorized to act in their stead.

Contracts for repairs or maintenance are made in the same way as for new work, a specimen form being inclosed herewith. These contracts are usually taken for 3 years at so much a running perch, according to the number of cubic yards of material required to be placed and named in the specifications. When the district surveyor directs the work of maintaining a road it is only for 1 year.

All new work and the placing of material for maintenance are required to be done during the months of June, July, and August. All material required for maintenance or repair must be prepared and delivered at stated places on the first of September for use the year following.

The board of works, a general body having jurisdiction over the entire island, can at any time repair roads neglected by the local boards over which her majesty's mails are carried, but the fund thus temporarily drawn upon must ultimately be recouped at the expense of the barony in which the repairs are made.

In the case of a sudden damage to any public road two local justices can direct repairs to the extent of £1 0 ($48.67) or in a similar emergency they can order repairs to a bridge to the amount of £50 ($243.32.)

How paid for.—The disbursements made in the construction and maintenance of public roads are from a fund derived mostly from a tax levied upon the taxable property in the barony where the work is done. The money is received annually by the grand jury from the baronial collectors. There are also some other sources of revenue derived from probate duties, Government bounty in lieu of rates, etc., partitioned

equally among the different baronies, and from local dog tax. The taxes paid by each barony for road purposes are collected twice a year, in June and December.

When a bridge is constructed involving a heavy outlay the expense is usually borne by the county at large and not by the particular barony in which it is located.

By virtue of a general law under which all roads are constructed none but a main thoroughfare, or one open at both ends, can be improved at the public expense, even though any number of taxpayers might file an application therefor. This is an important safeguard against injudicious expenditure.

As already intimated all financial transactions connected with the building and maintaining of public roads are conducted by the grand jury of each county. All payments are made to contractors quarterly on the certificate of the district surveyor that he is entitled to a certain amount for work performed. In Dublin County the details of this work are performed by a committee of twelve, usually composed of members of the grand jury. In all other counties the grand jury acts for itself. All accounts connected with road building and maintenance are audited once a year by a Government auditor.

(3) General effect of improved highways:

It has been impossible to get any definite statistics or information upon this point. I can only add that the system in vogue has been satisfactory and that the property interests pay the taxes necessary to its support willingly. The opinion generally prevails that the traffic of the country could not be successfully carried on with any less efficient system of highways than that with which the country is provided, and that full value is received for all expenditures made.

For a considerable part of the information necessary to this report, as far as it pertains to country roads, I am indebted to the kindness of R. T. Blackburne, secretary of the grand jury for the county of Dublin, and to Richard A. Gray, surveyor of the county of Dublin.

For the further information of parties who may be interested, I transmit herewith, under separate cover, a copy of the act of 1836, relating to the presentment of public money in Ireland, which covers the ground briefly traversed in the foregoing report. It differs only in some of the details to the act which applies exclusively to the county of Dublin. I also transmit herewith, under same cover, a volume containing presentments passed by the grand jury of the county of Dublin for the year 1890, which explains in detail the method of proceeding.

ALEX. J. REID,
Consul.

UNITED STATES CONSULATE,
Dublin, January 12, 1891.

SOUTH OF IRELAND.

REPORT BY CONSUL PIATT, OF CORK.

There is no radical difference between the city streets and the country highways in the south of Ireland. They are both made of macadamized limestone and are repaired with the same material. The repairing is generally done during wet weather, as the water in the ruts and hollows shows where the surface of the road is uneven and in need of repair. It also tends to keep the broken stones in place by softening the ground and thus allowing them to partly sink into it.

The grand jury has the power to grant permission for the construction of roads. These roads are divided into two classes with regard to the expense for construction and maintenance. That class called "mail roads," from being used by the postal authorities as routes for the mail cars, is built and maintained at the expense of the county at large in which the roads lie. The expense for the other class, called "district roads," is borne by the district in which the roads are situated. However, when a bridge or other work is to be made on a district road which will cost more than the district can afford, the grand jury may levy the expense incurred for the work in question on the rate-payers of the county at large, and then the road will be regarded as one which may be used as a mail route, though the district will otherwise pay for the construction and maintenance.

The expense of keeping roads in good condition depends upon the amount of traffic and upon their situation. The roads about Queenstown, in length about 9 miles, cost for maintenance from £350 to £400 per annum. This is a little above the average, I am told. These are the only details as to expense which I have been able to obtain.

As a general rule new roads enhance the value of the property in their vicinity by affording more direct or better means of communication, and especially by increasing the facilities for the conveyance of farm produce to and from the market towns and railway stations. There are very few instances where the value of property depreciates on account of the privacy of the place being destroyed.

JOHN J. PIATT,
Consul.

UNITED STATES CONSULATE,
Cork, May 15, 1891.

SCOTLAND.

DUNFERMLINE.

REPORT BY COMMERCIAL AGENT REID.

The towns included in this consular district are small, and possess so few of the elements of modern progress that they afford no adequate illustration of any advanced knowledge in the science of street con-

struction which concerns so deeply the prosperity and comfort of the larger centers of population and commerce. There being, therefore, no actual experience here in the matter of city streets which can have any real value in the way of testimony to guide the public inquiry now happily arisen in America, no response to this part of the circular of the Department on "streets and roadways" will be attempted. But on the subject of country roads, which interests all countries claiming civilization, and is rapidly commanding supreme interest in America, I have, with as much care as has seemed possible, collated all the data which road-makers and engineers regard as of practical value.

Adam Smith, who was a citizen of this consular district, and whose great work on the Wealth of Nations has perhaps more than any other cause influenced commercial legislation both in this country and in other lands, used no uncertain language on the value of public roads as one of the primary necessities of civilized life and national prosperity. Splendid roads had been constructed centuries before his time. Their continued existence fifteen hundred years after their construction proved the skill and care of the master minds who planned and built them. But they were constructed in the interest of war. Roads had to be built to move armies for conquest. Roads then became essential to hold the conquered countries. In these commerce had no element or consideration. Indeed it is not difficult to see that public roadways became thus the terror of nations. Even in this ocean-surrounded island, far from imperial Rome, the roads of the Cæsars entered and so terrorized the public mind that it was not until long after the middle of the eighteenth century that turnpikes were first authorized, and were even then inaugurated against the vigorous protests and prejudices of the common people. It seems strange also to know that to the Carthagenians, a people living on the northern coast of "Darkest Africa," must be given the credit of first inaugurating the public road as the necessity of commerce.

THE ROMAN ROAD.

The first inquiry made of a modern educated engineer respecting public roads leads inevitably to the reference to the methods pursued by the engineers of the Roman roads. Although constructed for the purpose of invasion and subjugation they provide still most instructive lessons in methods of construction. Adam Smith's assertion that "the construction of roads is the greatest of all improvements," and the saying of the Abbe Reynal that "wherever we shall find no facility of travel from a city to a town, or from a village to a hamlet, we may pronounce the people to be barbarians," have long, especially in Europe, been accepted by mankind. Roads are the acknowledged civilizers of the world. A road through "Darkest Africa" is fast ending human slavery and introducing light. A good road through Bad Lands would largely settle the question of Indian warfare. It is to methods of con-

struction to which public attention is now chiefly directed. The Roman roads, the via Appia, the via Aurelia, the via Flaminia, the roads to the Rhine and the Danube, and the 4,000 miles of road from the wall of Antoninus, in Great Britain, through Rome to Jerusalem, still reveal lessons of construction worthy of the study of the road builders of the nineteenth century.

The historian Gibbon says of these roads:

> They were accurately divided by milestones, and ran in a direct line from one city to another with very little respect for the obstacles of nature or private property. The middle part was raised into a terrace, and consisted of several strata of sand, gravel, and cement, and was paved with large stones, which, near the capital, were of granite.

The following description of the method of construction is given in the French Cyclopædia of 1836.

> (1) A cement of chalk and sand 1 pouce in thickness.
>
> (2) On this cement for the first bed large stones 6 pouces thick were placed on one another and compacted by hard mortar.
>
> (3) A second bed, 8 pouces thick, of small round stones, mingled with other broken pieces of building material not so hard, and mixed with a binding cement.
>
> (4) A third bed of 1 foot of cement made of rich earth mixed with chalk.

These beds formed a concrete of from 3 to 3½ feet thick. The whole surface was then spread with a gravel bound in cement mixed with chalk.

These roads were 16 feet wide in the middle, with two side roads 8 feet wide.

They were built either on a level or on a uniform inclination at an easy gradient.

Piles, stone arches, and protecting walls were used whenever the subsoil was not compact.

This road thus constructed has outlived fifteen centuries.

COUNTRY ROADS IN SCOTLAND.

Down to the middle of the eighteenth century the roads of Scotland were of the poorest character. Goods conveyed from place to place, where the distances were not great, were conveyed on horseback. Oatmeal, coals, turf, and even straw and hay were thus conveyed. That was the era of "cadgers." They supplied the country with salt, fish, eggs, and poultry. For longer routes carts were used. Through this very region to go a distance of 38 miles and return required 14 days. It took 14 days, in 1873, to go from here to London. Considering how old is the supposed civilization of this great country, one is surprised to read of one of its chief routes of travel as follows:

> I know not how to describe this infernal road. Let me most seriously caution all travelers who may accidentally propose to travel this terrible country to avoid it as they would the devil. I passed 3 carts broken down inside of 18 miles of execrable memory.

This is stated to show that road-making even here is not an ancient science. The first turnpike roads in Scotland were constructed in 1760,

and against the violent resistance and prejudices of the people, who regarded roads as aids to plunder. Except only the remains of the Roman road, the improved roads of this country are of comparatively recent origin, but are now constructed with the utmost care and maintained with scrupulous fidelity.

ROADS IN AND BEYOND FIFE.

The earliest stone roads built through and northward of this district were constructed by Abercromby, an engineer of some note, whose chief formula consisted of the following rules:

(1) Never make a road ascend a single foot unless absolutely unavoidable.

(2) Economy in maintenance depends on an easy gradient.

(3) Hilly roads are full of danger, expensive to maintain, and destructive to horses.

The great Highland roads were constructed with great care and skill and were adapted to the country through which they passed. Although traversing wild mountain ranges, easy gradients were everywhere secured and are unexcelled.

THE MACADAM ROAD AND THE STEAM ROLLER.

Two men of quite recent date were largely instrumental in the introductionof a general system, which is still maintained in its essential features. In 1819 Macadam elaborated his plan of road making and presented it to the British Parliament. Upon its general plan, a vast extension of the macadam road immediately followed.

Perhaps the most important auxiliary to good road making, and by many engineers deemed absolutely essential, was supplied by M. Polonceau in 1834, by the introduction of the steam roller. Excepting a very decided variance of opinion on the comparative advantages of soft and hard foundations, the macadam road is the generally accepted road of the country for country roads, and has stood the test of long and varied experience.

RESISTANCE TO TRACTION.

A few years ago road-making science expressed itself as follows as to traction:

(1) Resistance is directly proportional to the load and inversely to the diameter of the wheel.

(2) Upon a paved road the resistance is independent of the width of the tire when it exceeds 3 to 4 inches.

(3) At a walking pace the resistance is the same to carriages with or without springs, but increases on macadam roads with the velocity, and less as the road is smooth and the carriage less rigid.

(4) On soft roads or freshly graveled roads the resistance to traction is independent of velocity.

(5) The destruction of roads increases with reduced wheel diameter and in carriages without springs.

GRADIENTS.

The steepest gradient, according to one authority, that can be properly allowed on roads with a broken-stone covering is about 1 in 20, as this, from experience, according to the same authority, is found to be about the angle of repose upon roads of this character in the state in which they are usually kept. Engineers of eminence insist, however, and with apparent justice, on a much lower grade. Sir John Macneil asserts, as a fact not generally known, that "if a road has no greater inclinations than 1 in 40 there is 20 per cent. less cost for maintenance than where the inclination of the road is 1 to 20. The additional cost is due not only to the greater injury by the action of horses' feet on the steeper gradient, but also to the greater *fatigue* of the road by the more frequent necessity for sledging or braking the wheels in descent."

The same authority adds: "Experience teaches that on broken-stone roads in perfect condition the resistance to traction is of the gross weight or 45 pounds per ton, for which the angle of repose is 50. The traction force required is just double that which is required on a level."

FOUNDATIONS.

Mr. Macadam maintained that a soft and yielding foundation for a road is better than one that is firm and unyielding. He argued that a road on a soft foundation being more yielding and elastic the materials of which the covering of the road was formed would be less likely to be crushed and worn away by the passage of a heavy traffic than on a hard solid.

This theory of road foundation is still held by some, but rejected by the majority. Experience seems to have proved that there is no more general cause of bad roads than soft foundations. A firm, solid, and dry substratum is necessary for the road materials to rest upon. The outer surface of the road, it is urged, should be regarded merely as a covering to protect the actual working road beneath, which should be sufficiently firm and substantial to support the whole of the traffic to be carried over it. The lower, or subroad, properly provided for, and the upper covering renewed from time to time, should last forever. The following are directions now generally in force.

Where the expenditure is limited and the traffic moderate every care should be taken to make the roadbed as solid as possible. If the ground is wet, deep ditches should be cut on each side, and cross underdrains should be formed.

Where the ground is very soft a layer of faggots or brushwood from 4 to 6 inches thick should be laid over the surface of the ground to receive the road materials. Where the ground has been recently deposited the surface should be rolled or beaten to render as solid as possible.

CONCRETE FOUNDATIONS.

Macadam's theory of the advantage of soft foundations, especially when made to apply to roads likely to bear a heavy traffic seem now very generally discarded. In roads subject to heavy travel concrete is insisted on and has shown proof of its value. From a leading authority the following quotation is made :

The concrete used is similar to that used on the old Roman roads. It is a mixture of gravel and lime. The lime is ground to a fine powder, water is added and every particle of the lime slaked and saturated.

The bed of concrete having been spread to the depth of 6 inches the surface is then covered over with 6 inches of good hard gravel or broken stone, and this depth is laid on in two courses of 3 inches at a time, the first course to be laid on a few hours after the concrete has been placed on the road. The covering of gravel is laid before the concrete has become hard, to admit of more perfect junction between the two beds. The lower stones thus united become a fixed matrix and not easily dislodged. On some roads where the obstacles to sound foundation were great and apparently insuperable, the use of cement or concrete foundation has been eminently successful.

One of the principal advantages of using concrete is that a good and solid road can be made with material such as gravel, which is usually readily found, and which on any other mode of application would be unsuited for the purpose. The gravel should be clean and mixed with sand and then mixed with one part of lime to six of gravel. On adding water the whole should be quickly and thoroughly mixed up, thrown into place, and the first layer of broken stone or screened gravel be placed just as the concrete is about to set.

THE MACADAM THEORY.

In 1816 James L. Macadam put in practice his system of roadmaking, which is eminently worthy of restatement in this inquiry. His principle was "to put broken stone upon a road which shall unite by its own angles so as to form a solid, hard surface. When this material is thus laid upon the road it must remain in the situation in which it is placed without ever being moved again, whereas gravel, before it becomes useful, must move its situation and be in constant motion." The principle was "to substitute small angular stones such as resulted from the breakage of larger stones, for rounded stones, so as to form a sort of mosaic or interlocking system."

This system, which experience has thoroughly tested and approved; the provision of solid foundations, which seems to be proved of the first importance; and the use of the steam roller in securing thorough impact, are the three vital elements of the successful modern road.

On these three principles of road building the following roads have been extended within a comparatively short period:

	Length of road.	Area.	Population.
	Miles.	*Sq. miles.*	
Great Britain	160, 000	122, 519	30, 621, 431
France	100, 048	210, 460	38, 192. 064
Prussia	55, 818	139, 675	23, 970, 641
Spain	10, 886	198, 061	15, 673, 481

CONVEXITY OF ROADS.

Macadam gave the following testimony before a committee of the House of Commons, and which is practically the judgment of the most experienced road builders:

"I consider that a road should be as flat as possible with regard to the water flowing off, because a carriage ought always to stand upright. I have generally made roads 3 inches higher in the center than at the sides, and on this slope the water will easily escape. When the road is made flat people will not follow the middle of it as they do when extremely convex. More water will stand on a very convex road than on a flat, because all carriages seek an upright position in the center, and the wear there will, of course, be greater. The most useful inclination is in the direction of a road's length, and engineers give preference to a moderately inclined road over one rigidly level. To secure an equal distribution of service every part of a road should be equally hard and good to prevent unequal wear."

HIGHWAYS IN THE DUNFERMLINE DISTRICT.

I am indebted for much of what follows to personal interviews with and documents furnished to me by John Maclennan, esq., for some years president of the association of road surveyors for Scotland.

(1) *Road routes.*—Other things being equal a road route should be chosen having the freest exposure to sun and wind.

(2) *Gradients.*—Gradients should not exceed 1 in 40. Easy gradients are preferable to dead levels, securing drier and more compact roads.

(3) *Foundations.*—All roads should have foundations to be determined by the character of the soil on which they are laid. On roads of moderate travel, the soil light and the natural or unstoned road, well compacted, unbroken and of easy gradient, the necessity for special foundations is absent, and, according to Macadam, unnecessary. Wherever, however, the surface is broken either to elevate or depress, the ground should be well rolled or tamped. Where the soil is soft and yielding or an active traffic is likely, the foundations become important. Stones laid on their flattest side and compacted with broken metal, ashes, or the like, require to be carefully laid. Even cement, in which gravel forms a useful constituent, becomes essential if the nature of the soil is yielding and the traffic heavy. New macadam roads are now generally made with a foundation from 6 to 12 inches of stone shivers, slag, brick rubbish, or other inferior character, on which 6 inches of hard metal is laid.

(4) *Drains.*—In forming road foundations the proper provision of drains is important. These, whether by side ditches or by lateral or transverse carefully constructed drains, are essential to a good and economical maintenance of a road under the best conditions. Existing conditions will determine their character and mode of structure.

(5) *Character of stone.*—The stones employed on Scotch roads are of the hardest and toughest attainable. In these the granites are by far the most serviceable, and that because of their unstratified character. Granite, named so from its coarse granular structure, has for its prevailing elements a crystalline compound of three simple minerals—feldspar, silica or quartz, and mica—silica varying in proportion from 65 to 80 per cent. and usually in an amorphous condition, cementing the feldspar and mica. Granite is capable of absorbing 10 pounds of water per cubic yard=1.450 of its weight. Perhaps the most valuable stone for macadamizing roads is the Welch stone, greywacké of Penmaenaur, in Wales, which, while of the same weight as granite, is much harder and is so highly esteemed that enormous quantities are sent by ship and rail to the large towns in the north of England, Scotland, and Ireland. This shows the value of hardness in the metal for public roads. The following table may be of interest:

Stone.	Specific gravity.	Crushing resistance per square inch.	Weight of water absorbed in 48 hours.
Graywacke	2.75	7.54	1 part in 1641.
Granite, Scotch	2.67	5.74	1 part in 490.
Sandstone, English	2.41	4.38	1 part in 47.

Of Scotch granites Guernsey is the most durable. The most important quality in stone for roadmaking is toughness. Mere hardness without toughness is of no use, as such stone becomes rapidly reduced to powder by the action of wheels. The sandstones and the limestones are to be avoided because of their affinity for water, by which in frosty weather, which has been preceded by wet, they are split up into powder and the solidity of the road is destroyed.

(6) *Breaking the stone.*—The quality of stone proper for the metaling of the road is scarcely more important than its preparation. It should be reduced to angular fragments of such a size that each piece will pass freely through a ring of $2\frac{1}{2}$ inches in diameter in every direction. Broken stone is superior to gravel, and, wherever obtainable, should always be employed. Pebbles, when cleaned, never bind until they become ground and wornd own and are incapable of supporting the pressure of heavy wheels. If gravel be employed, experience seems to indicate that it is best to leave some binding material to adhere in order to secure firmness and cohesion.

There has been introduced into the service of the roads in this district a stone-breaking machine with good effect and economical results. The comparative cost of breaking stone by machine and hand labor is as 1*s.* per ton for the former against 2*s.* 3*d.* per ton for hand labor. In a trial of the two systems 3,325 cubic yards of stone broken by machine cost £169 18*s.* 7*d.* while the same quantity broken by hand cost £398 4*s.*

(7) *Metaling the road.*—The foundation of the road having been care-

fully provided, and which, as has been stated, can be done either, for roads of moderate travel, by thoroughly drying and solidifying the soil by tamping or rolling, or, as recommended by able engineers, for roads of larger travel, of using soft stones or cinders, the stones being "carefully set by hand, broad end down, in the form of a close, neat pavement," there shall then be placed 6 inches of broken stone to such width as may be desired, but so laid that the entire width shall form a convex line or segment of a flat ellipsis the arch of which shall not exceed 6 inches in 30 feet. This shape not only assists the water to pass from the center toward the sides, but contributes to the drying of the road by allowing the action of the sun and air to produce a great degree of evaporation. The use of the steam roller in at once compacting and smoothing the road, it is believed, is becoming more and more acceptable, and producing, both in construction and repairs, very useful results.

(8) *Road repair.*—The following quotation from a report of Government Surveyor Maclennan is pertinent and complete:

> The chief end of road repair is a smooth, hard, and slightly elastic surface. To secure this the metal should be of uniform size and quality. Small 2-inch whinstone metal is, in my opinion, the best. Large metal, although ever so well blinded and rolled, will in a very short time present an uneven surface, not having the same capacity for forming into the concrete as when smaller. Hard and soft stones should not be mixed. The soft stones are quickly ground into mud, while the hard protrudes, rendering the surface rough and uneven. When the surface is very sorely worn I apply a small sprinkling of clay to give a bed for the new material. Work of this kind requires experience and care. I believe in giving good convexity to the road. Water should run off quickly to avoid great waste and damage. After distributing metal a stone roller of 1 ton weight is used to secure a fair surface. In the matter of "blinding" I am convinced that where the subsoil is retentive and the surrounding ground wet, spongy, and of a clay nature, the less blinding the better for the road. A smooth and beautiful surface may be quickly secured, but the deterioration is equally rapid. The men appointed for surface repair have much to do with the road's success and should be selected with great care.

(9) *Foot roads.*—The provision of foot-paths is important, but seems not generally provided for. When made the refuse of the road and gravel are used.

(10) *Depots.*—On all important roads depots of stone occupying a small space, more or less frequently, along the margin of the road are provided, where the stone is broken, generally by hand, and kept ready for use.

(11) *Effect on property valuation.*—To this inquiry the prompt reply was: "Roads are the life and necessity and hope of all Scottish industries, and their value increases rather than diminishes with railroad extension. Property would without them be comparatively valueless."

(12) *Cost of maintenance.*—The cost of maintaining the public roads in this district averages £18 per mile, and is provided for by a tax averaging 6*d.* on the pound of rentals, equal to about 2 per cent. They are under the supervision of a surveyor appointed for each district, a

master of works for each town of importance, all other labor being employed for brief periods or for special work. Wages of "surface men," 18*s*. per week ($4.50).

(13) *Cost of construction.*—The cost of construction of an ordinary public road eighteen feet wide would be, in Scotland, about £300 per mile. Any increase in cost would depend on increased width of road, distance of quarry, and method of foundation. As in many other things, the cheaper the construction the more costly the maintenance.

Such is my response to the Department circular of November 8, 1890, based on as complete information as is available to me; yet it is sent with hesitation as being to some extent, perhaps, crude and incomplete.

JAMES D. REID,
Commercial Agent.

U. S. COMMERCIAL AGENCY,
Dunfermline, January 1, 1891.

GLASGOW.

*REPORT BY CONSUL BROWN.**

The streets of Glasgow are the best paved of any city with which I am acquainted; the roads of Scotland are certainly very superior, and as far as I have been able to observe, better, as a whole, than those of the other countries of the United Kingdom.

SCOTCH HIGHWAYS.

Road system.—The country road system of Scotland may be regarded as a growth to meet the wants of the public and as a result of experience in carefully providing for, by studying the best methods, the public needs, its present state of excellence, approaching perfection, not having always existed, though for scores of years Scotland, even in the Highlands, has been famous for her good roads.

A hundred years ago the population in some districts was already becoming quite dense, and the need of good roads and how to build them naturally commanded the attention of the public and officials. Sixty years ago and before the country was interwoven with a network of railways and when traffic and travel were already considerable on the great stage routes to London, as well as to other leading centers, good roads were more than a luxury; they became a necessity and required to be perfected and kept up at any cost. What wonder, then, that the roads now are in excellent condition everywhere.

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* In connection with this report I am indebted to Dr. W. H. Hill for valuable documents, and to John L. Imrie, esq., a farmer residing near Glasgow, for much practical information.

L. W. B.

Comparatively few new roads are now being built, because not needed, but the old ones are constantly being improved by cutting down high grades, filling in the low places, renewing the top dressing, etc.

This cutting down and leveling of the roads, when done by contract, costs 20 to 28 cents per cubic yard, which cost includes removal and dumping into the low places if the distance is not too great.

A considerable force of men is kept constantly employed improving and repairing the roads, the counties or shires, for road purposes, being divided into divisions, these being subdivided into districts, the latter embracing from 15 to 30 or more miles of road. The districts are in turn subdivided into sections, upon which squads of men, from three to six in number, according to the needs of the road, are kept constantly at work the year round.

A heavy steam-roller, 10 to 15 tons, plays an important part in road repairing as well as road making, and though of comparatively recent introduction is now regarded as essential, the larger or 15-ton roller being considered the better and more economical. One roller, with its complement of men, does its part of the work upon several of the above-described sections. Cost per diem of using these rollers will be considered hereafter.

CONSTRUCTING NEW ROADS.

The first step in constructing a new road is to lay tile on each side of the roadbed, the tile as a rule being laid 3 feet below the surface and ranging in size from 3 inches to 6 or more inches, the cost of laying, exclusive of the tile, being for 3-inch tile (reducing to United States currency) 3 cents, 6-inch tile 4 cents, and 9-inch about 6 cents per yard. The latter size is seldom used.

In preparing the roadbed the upper or surface soil to the depth of 8 to 12 inches is first removed; upon this exposed surface or bed a foundation is laid, called "bottoming," which consists of large cobble or broken stone, carefully set, the stone foundation thus formed being 6 to 10 inches deep, according to size of stone used, the cost in a great measure depending upon the accessibility of stone. Upon this rough roadbed or foundation is scattered fine broken stone called metal, and fine enough to pass through a 2-inch ring, to the depth of 4 inches, in addition to filling up interstices of the bed-stone. This metal costs from 72 cents to $1.68 per cubic yard, according to quality, the latter price being paid for a choice quality almost equal to granite in hardness and durability.

The whole is made a compact mass by throwing on gravel, sand, or the refuse of the broken stone heaps, and if these are not attainable in sufficient quantity, sometimes soil nearest approaching sand is used; this is wet down, a large quantity of water being used, and rolled many times over, until the whole becomes almost as firm as a stone pavement sufficiently smooth for a delightful carriage road and nearly perfection for carting purposes.

This roadbed is built from 16 to 30 feet wide, according to volume of travel expected, and in the case of the narrower width is about 7 inches higher in the middle than on the sides and in the broader width about 1 foot higher in the middle. A sufficient depression is made on either side to carry off the surface water.

This, I am sure, will be accepted as pretty nearly a model country road, but it is not all of the road for in addition there is built on one or both sides of the road a footpath from 2½ to 4 feet wide, this being a feature of all the newer roads and many of the old ones. This footpath or sidewalk is made by simply throwing up the soil a few inches higher than the side of the road and covering it with coal ashes or cinders, gravel, or like substance, and after being worn for a little time is almost equal in dryness to the city sidewalk and is quite as comfortable to walk upon.

Roads thus built are durable in character, yet do require repair, and to keep them in a high state of repair and excellence, as heretofore stated, a considerable force of men is constantly employed.

REPAIRING OF ROADS.

Keeping the roads in proper repair consists in keeping them clean, removing dirt, droppings, and rubbish of all kinds, and in filling up depressions with fresh metal, rolling down, etc. In this connection it may be well to state that the roller is employed upon all parts of the road, even when new metal is not spread, it being considered very useful in keeping the road solid and preventing depressions, which would require filling up. The cost of these repairs is very considerable, as will be seen from the following:

I take at random from the tables of estimated cost before me—the sixth district of the county of Lanark. The district comprises 16¼ miles of road upon which there is a heavy traffic. The estimated cost of management and maintenance for the year 1891 is as follows:

	£	*s.*	*d.*
Metal (fine broken stone)	1,627	5	9
Surface work	589	9	6
Tools	15	7	4
Removing mud, etc	194	6	0
Footpaths and borders	85	16	6
Drains, gratings, etc	349	7	9
Repairs on walls, fences, etc	105	13	2
Improvement on Carmunnock road	665	0	0
Cost of working steam road roller, including driver's wages, fuel, carting water, etc	239	14	11
Sundries	18	3	9
Total	3,890	4	8

Equal to $18,906.52 United States currency.

From this total there should be deducted the cost of the improvement of Carmunnock road, which leaves a balance of £3,225 4*s.* 8*d.* or, in round numbers, $15,675, nearly $965 per mile of road.

Twelve men are employed upon the roads of this district. Of these twelve men two receive $6.07 each per week, one $4.86, two $4.62 each, six $4.38 each, and one $4.14 per week.

The following table shows the cost per diem of the roller wages, viz:

1 engine driver	$1.04
1 assistant	68
1 watchman	64
1 man blinding metal	72
2 men for water, at 72 cents each	1.44
2 men for sweeping, at 72 cents each	1.44
Foreman or surfaceman of the district, $1 (say half his time)	50
Cartage:	
2 water carts, at $2.16 each	4.32
1 cart for blinding, $2.16 (but as this would, without the roller, be required, say to one-third the extent)	1.44
Materials:	
Coal	30
Oil, packing, etc	16
Brooms	16

Interest and depreciation at 15 per cent. per annum on cost of roller, $2,433, and for repairs and insurance, $364.50. Deduct from last item 52 Sundays and 42 days for frost, in all 94 days, the charge in respect to above is per working day $1.30.

To the expense of management the following items should be charged, being approximate cost of management for a county:

Salary of secretary and treasurer, £600; surveyor, £400; collectors commission, 2½ per cent.; carriage hire and expenses of inspectors, say, £100; printing, stationery, advertising, postage, etc. Total, say, £1,500, nearly $7,500.

The official machinery made use of, construction of committees, of county council, for road management, quite unlike our own, and as I think rather cumbersome, is not considered essential to this report and is therefore omitted.

It may be an interesting item to note the length of time some of the men are employed. In the district of which I have given a detailed report, one man, Andrew Hamilton, has been continuously in service 50 years. He is now 70 years old and receives $6.06 per week. Another man has worked 26 years, one 16 years, one 14, and the other eight from 7 years down to 6 months.

TAXATION FOR ROAD PURPOSES.

The assessment is made upon the rental value of real estate, and at the rate of 6*d.* to 8*d.* per pound sterling, paid in part by the owner and part by the occupier, usually one half by each. Take the 8*d.* per pound rate, allowing £2 ($9.73) as the minimum rental value of farming land, and the valuation of our farm lands would surely average that much or more, we have $25.60 annual tax upon a farm of 80 acres, for repair

and maintenance, after first cost is paid. When our people are ready to pay such a price, we can surely have first-class macadamized roads, equal to those of Scotland.

As to the question of enhanced value of real estate on account of improved roads, I can only conjecture. I am informed by intelligent farmers that the rental value of farm lands is at least 5 per cent. higher where the roads are such as I have been describing than where the roads are but ordinary or poor. The land for the most part is owned by landlords and seldom changes hands; but it is safe to assume that the value is increased from 20 to 25 per cent. by good roads.

STREETS OF GLASGOW.

Pavements in use in Glasgow are of three kinds, viz, granite or whinstone, macadam, and wood. The latter, however, has not been extensively used, hardly sufficient to be worth mentioning, is considered a failure, and when worn out will doubtless be replaced by one of the others. I think there is less than a mile of wood paving in the city, hence its construction is not described.

A. B. McDonald, esq., city engineer, to whom I am indebted for information in relation to Glasgow street paving and other courtesies as well, writes me that:

The whole of the streets within the city of Glasgow with the exception of the old turnpike and Statute Harbor roads have in the first place been formed and paved by the proprietors at their own expense, principally with flat topped rough whinstones called rubble whinstone causeway. Turnpike roads were originally formed and maintained out of funds raised by the levy of tolls, the description of paving used being what is known as macadam. These streets when taken over by the city authorities to be maintained out of city rates have been gradually remade and repaved to suit the altered requirements in regard to traffic, gradient, and nature of occupancy of abutting buildings.

TRAFFIC.

Mr. McDonald further says:

In determining the most suitable material for paving, heavy and light traffic is calculated on "actual teaming," not the weight of any load which may be expected to pass over it, as all the roads paved with square dressed sets are expected to bear, with safety, the passage of loads of from 60 to 80 tons carried on four-wheel bogies.

The heavy traffic is principally on the main thoroughfares and the streets in the portion of the city occupied by warehouses, stores, and business premises. These as a rule are paved with square dressed granite, exception being made in such portions of streets as front law courts or infirmaries, where wood blocks or macadam are laid for the prevention of noise.

The light traffic is of two classes, one a combination of goods and carriage traffic and the other solely carriage traffic. The first embraces the streets partly occupied for residential and business purposes, in which the paving material is whinstone, the latter, for residential purposes alone, being paved partly with whinstone and partly with macadam.

PAVING MATERIAL.

The granite used for paving sets in Glasgow is a close-grained porphyry from the Scotch quarries, situated on Loch Flyne and Loch Etive, and has been proved to be

the most durable material for paving purposes to be found in the country. Under heavy traffic it has been found to last for 30 years without requiring to be lifted, and when dressed and relaid, is expected to last for another 25 years, before being broken up for macadam, or laid in streets subject to light traffic. The granite metal largely used in macadamized roads is from the same quarries.

The granite used for water channels, not being subject to the same wear as the street, is brought from the Dalbeattie and Ardshiel quarries; it is larger in grain and softer in quality, but of a lasting nature.

The whinstone, principally from quarries around the city, is heavy and close-grained, and while not so lasting as granite, lasts as long under the lighter traffic to which it is subjected in the minor thoroughfares where whin paving is adopted. It is not so slippery as granite, and on this account is used in several of the heavy traffic streets where the gradient is pretty heavy. Whin metal from the same quarries is also largely used for macadamizing purposes.

The securing of a sure foothold for horses is an important factor in determining the sizes of sets for paving purposes, and on this account no paving blocks now being used exceed in breadth 4½ inches or in length more than 9 inches. In some cases they are now laid as narrow as 3 inches; but with such a breadth there is the disadvantage that when they become worn and require to be lifted they will not redress to advantage, while a stone 4 to 4½ inches broad can be depended on to redress and relay well. At street junctions where a foothold is required in all directions the sets are square instead of oblong, not exceeding 4½ inches on the top. The depth of the stone may vary from 7 to 5 inches, and in the case of junctions where the form of the stone does not admit of much depth they may be from 6 to 4 inches deep. The same remark as to after facility for redressing and economy holds good in regard to depth.

Water channels are of dressed stone from 12 to 14 inches broad, 6 to 7 inches deep, and of an average length of 3 feet. It should be borne in mind that these sizes of sets, etc., are those now used. On many of the streets, the pavements having been laid many years ago, the sizes are larger.

In all cases, whether as a paved or macadamized road, it is considered of the utmost importance to secure a properly consolidated foundation. For this purpose the roadway is excavated to the required depth and to the levels and curves of the intended surface, all soft places being rammed solid, or, when necessary, such as over drains and pipes recently laid, cut 6 inches deeper and filled up with concrete. As I have watched the work going on no part of the work has so much impressed me as the thoroughness with which the roadbed is prepared.

The specifications herewith sent, furnished me by Engineer McDonald, fully describe the manner of carrying on the various works connected with the paving of the streets, while the schedule attached gives the prices paid under the present contract.

Attention is called to the use of both cement and asphalt for paving purposes, the former being generally preferred for use in bottoming, but for grouting paving sets the latter, because it sets in a few hours and allows the more rapid use of the street. For this reason in some cases it is necessary to use asphalt for both bottoming and grouting purposes.

MACADAMIZED STREETS.

For macadamized streets the same care is observed in excavating to the required depth, which in this city varies from 18 to 20 inches below the intended finished surface. In forming a first-class macadamized

road Mr. McDonald says "a co ting of engine ashes or some similar substance 2 inches deep should be laid over the excavated surface wherever the soil is of a non-porous nature; where of sand or gravel or other absorbent material the ashes may be dispensed with." Heretofore this has not always been done. Upon this is laid a bottoming of rough stones (sand stones if possible) 9 inches deep and not more than 4 inches broad on the head when laid, all carefully hand set and so lapping in the joints as to present the appearance, when completed, of a dry stone wall laid flat, the open joints being filled with the small chippings and the surface even, no stone projecting beyond another. On this is laid a coating of from 4 to 6 inches of 2½-inch metal, which, after being blended with sand and watered, is gone over with a 15-ton steam road roller to be consolidated; a second coating of 2-inch metal mixed with a proportion of small ground whin or granite, according to the nature of the material with which the road is to be finished, is then put on and again watered and rolled.

As the road consolidates under the rolling 12-inch metal is laid on and rolled in until the necessary finished level has been attained. A proportion of road scrapings is used where it can be got along with the ground chips for the purpose of binding the metal.

It is found that granite metal makes a more perfect road and does not require so much cleansing as the whin.

It is considered desirable in all macadamized roads that the sides should be paved with square dressed sets with properly laid channel stones.

The cost of forming a macadamized roadway as described, including rolling complete, varies from 3*s.* 6*d.* to 4*s.* (84 cents to 96 cents) per square yard.

Mr. McDonald says: "No street is considered as permanently paved" until it is causewayed with square dressed sets. The money required for this work is borrowed under parliamentary powers, the interest upon same as well as the annual amount required as sinking fund being chargeable against the rate-payers. The rate of interest is partly 3¼ and 3½ per cent.; the sinking fund upon the amount of debt to be repaid, as at the passing of the roads and bridges act, 1878, is 2½ per cent., and upon all sums borrowed since passing of said act 5 per cent.

The total amount expended in permanently paving the streets in Glasgow from May 15, 1856, till May 31, 1890, has been £538,714 15*s.* 4*d.*

The net cost of repairing the streets in Glasgow during the year ending 31st May, 1890, was £18,585 7*s.* 7*d.*

The number of miles of streets maintained by the road authority in Glasgow is 142, this being exclusive of suburbs, which would nearly double the amount.

L. W. BROWN,
Consul.

UNITED STATES CONSULATE,
Glasgow, March 2, 1891

SPECIFICATION FOR EXECUTING THE PAVING WORK REQUIRED BY THE MAGISTRATES AND COUNCIL OF GLASGOW (POLICE), INCLUDING THE SUPPLYING OF THE NEW PAVING SETS, CHANNEL STONES OR WHEELERS, AND ALL THE MATERIALS AND WORKMANSHIP, FOR THE PERIOD OF THREE, FIVE, OR SEVEN YEARS.

The paving operations to be commenced within 6 weeks from date of acceptance of offer, and the streets finished and open for traffic within such period as may be from time to time fixed by the statute labor committee.

Paving stones.—Each set must be properly dressed, squared, and level on the tops and beds, the sides and ends to be parallel and square. The sets must be of the sizes as marked on the schedule, truly gauged, and approved of by the master of works. No bulges or hollows will be allowed on any pretext whatever.

Channel stones or wheelers.—To be neatly axed, perfectly straight and square on the upper surface, the sides and ends perfectly straight, parallel and square off the surface, and the bed parpend with the same. The stones to be 10, 12, 13, 14, and 15 inches broad, and 5, 6, and 7 inches deep. The average length to be 3 feet 6 inches, and no stone to be less than 2 feet 6 inches long.

Crossings.—Paving sets for crossings to be axed on the top, but in every other way to be the same as those already described, and of the sizes as marked in the schedule.

(NOTE.—These are never required. The ordinary sets above specified are found to do sufficiently well.)

Removal of present paving stones or macadamizing.—The present paving stones, which remain the property of the magistrates and council, to be carted away in sections by the contractor to ground or streets as directed by the statute labor committee. The square sets intended to be relaid to be redressed to the sizes as specified in the schedule of rates, and to the entire satisfaction of the master of works, the redressing to be done at such place as the master of works may direct, the contractor being bound to cart the stones to the street in which they are to be used after they have been redressed.

Excavation.—After the present paving sets have been removed, the street to be excavated to the depth of 12½, 13½, 14½, or 15½ inches (to suit the different depths of stones) below the intended finished level; the necessary transverse curve or rise from the sides to the center being given to the bed. Where the streets are to be paved with redressed stones, the street to be excavated to the depth of the sets in the same proportion as above stated.

Where the streets are macadamized, the contractor to remove the macadamized material and excavate the streets to the depths before stated. The macadamizing may be used for bottoming, so far as found suitable for that purpose, but it must be thoroughly screened in order to remove any sand or mud.

Bottoming.—After the ground has been carefully prepared to the required sections, a bed of the best whinstone metal, 6 inches in depth, broken to pass through a 2-inch ring, shall then be laid over the whole surface of the roadway, be thoroughly grouted with a mixture of the best British bitumen and pitch oil, and thoroughly beaten with a rammer while being grouted, the finished surface to be perfectly smooth. The whinstone metal must be thoroughly dry before being grouted with bitumen.

In the event of the board deciding that a concrete bottoming be substituted in place of the foregoing, it shall be composed of 1 measure of the best Portland cement to 1 measure of clean sharp river sand and 3 measures of Whinstone Metal, broken to pass through a 2-inch ring, all properly mixed previous to being laid on the roadway. The surface of the compound, when placed in its position, must be perfectly smooth and to the entire satisfaction of the master of works. The contractor to state whose Portland cement is to be used.

Causewaying.—The whole prepared surface to be paved with square dressed sets, assorted according to size, both as to width and depth, before being laid, and set on a bed of sharp clean river sand, in no place less than 1½ inches in depth. The sets to be laid (close up, hard to hard on the sides and ends, and properly banded) in

straight and regular courses across the street between the channel stones, and to levels shown on the sections, proper molds, carefully set every shift, being used if required for guiding the workmen, the whole to be afterwards well grouted with Portland cement and bitumen, and beaten down with a beater not less than —— pounds in weight, and regrouted, as also blinded with gravel, one-fourth inch in depth. If considered necessary by the master of works, the contractor is bound to put on blinding a second time. The master of works to give instructions as to size of sets to be used in every street.

Grouting.—Cement grouting to be composed of one measure of best Portland cement to two measures of clean sharp river sand, all properly mixed.

For bitumen bottoming and grouting, the bitumen shall be manufactured from pure coal-tar pitch from gas works, and the oil shall be of 1.000 to 1.10 specific gravity. Sufficient oil shall be used to produce a plastic grout. The contractor shall also be careful to see that the grout is boiling hot when used. The contractor to intimate to the master of works the name of the parties from whom the bitumen is obtained.

When the master of works considers it necessary that chips of the same class of material as the paving set should be used in the filling in of the joints, the chips must first be passed through a half-inch riddle, then be thoroughly kiln dried, and afterwards passed over a riddle of one-quarter-inch mesh to remove all sand and dust, and laid in the joints in two layers. Previous to the chips being put between the joints, bitumen shall be run in to the depth of 1 inch, the first layer of chips shall then be put in, and thoroughly grouted with the bitumen, the second layer of chips to fill the joints level with the surface, and to be thoroughly grouted as directed. One ton of chips shall not do more than 240 square yards.

Labor, carriage, etc.—The contractor to find all labor, tools, and plant, carriage, sand, whinstone metal, gravel, bitumen, cement, paving sets, and all other materials required for the execution and completion of the contract.

Watching and lighting.—The contractor to be bound to provide a sufficient number of watchmen and lights, and become responsible for any damage that may be done to life or property in consequence of his operations, or from deficiency of watchmen or lights.

Maintenance.—The contractor to be bound to maintain the work for 6 months after its completion, and to deliver the same over to the board in a proper state of repair at the end of that period.

Materials and workmanship.—The materials to be of the best quality, from any quarry or quarries that may be approved of by the committee. The workmanship to be of the best description, and to the entire satisfaction of the master of works, or of any person appointed by him to superintend the work, who shall have power to exclude or reject any defective material or workmanship; and, in the event of the contractor delaying or refusing to replace the materials or renew the work, the committee shall have power to do so at his expense.

The contractor to lodge specimens (carriage free) of all the different sizes of stones specified, at the master of works' office, 6 days before offers are lodged. These stones will become the property of the magistrates and council, and will be held as samples of the dressing of the stones to be supplied under the contract.

Payment.—Payment to be made to the extent of 90 per pent. on the value of work done monthly, the work to be measured when finished, and the balance to be paid when the master of works shall have certified that the work has been done and maintained as before specified, and delivered over in terms of contract. Should any repairs be necessary at the end of the period fixed on for maintenance, the same shall be made good by the contractor, and, in the event of his failing to do so, the committee shall have power to order the same to be done; the expense so incurred to be chargeable against contractor, and to be deducted from any balance which may be due to the contractor at the time. One-half of measurer's fee to be paid by the contractor.

Alterations.—The committee reserve power to make whatever alterations, additions, or deductions they may consider necessary; the price of such alterations, additions, or deductions to be regulated by the rates of prices contained in the contractor's tender.

Completion.—The contractor to proceed with the different portions of the works as directed; and should it appear to the master of works that at any particular time the work is not being proceeded with in such a manner as to secure its completion within the time specified, the committee shall have power to take the work out of the contractor's hands, and complete the same at the contractor's expense.

Power of dismissal.—Should the master of works, or inspector appointed by him, be dissatisfied with the method of conducting the work, or of the workmanship thereof, as conducted by any foreman or workman employed by the contractor or contractors, they shall have the power to order his or their instant dismissal.

Disputes, etc.—In the event of any difference of opinion or dispute arising between the master of works, or his inspector, and the contractor, the same shall be referred to ———, whose decision shall be final and binding on both parties.

Contract.—The contractor or contractors will require to enter into a deed of contract, based on the foregoing specification, and the accepted tender, containing the above and the usual conditions, and to pay one-half the expenses thereof.

Tenders to be lodged with Mr. Lang, clerk to the magistrates and council (police), 74 Hutchinson street, on or before the ———, indorsed "Tender for paving work." No tender will be received after 12 o'clock of said date.

The magistrates and council do not bind themselves to accept the lowest, or any tender.

OFFICE OF PUBLIC WORKS,
74 Hutchinson street, Glasgow, ———.

TENDER.

——, ———, 18—.

To the MAGISTRATES AND COUNCIL OF GLASGOW (POLICE):

GENTLEMEN: —— do hereby offer and agree to execute the work with connected the paving of streets in the different districts of the city, as pointed out by the master of works, for the periods of three, five, or seven years from the acceptance of this offer, with new granite, whin, or old redressed stones, all in conformity with the specification thereof, and at the following schedule rates.

Your obedient servant,

——— ———

Schedule of rates for executing the paving work required by the magistrates and council of Glasgow (police), including the supplying of the new paving sets, channel stones, or wheelers, and all the materials and workmanship, for the period of —— years.

BOTTOMING WHERE REQUIRED.

	s.	d.
Whinstone bottoming, 6 inches deep (including cutting), grouted with bitumen as described, including all materials and workmanship (removal of present causeway or macadam included in all paving work) ..... per sq. yard..	3	0
Concrete bottoming (including cutting), 6 inches deep, as described, including all materials and workmanship (removal of present causeway or macadam included in all paving work) ..... per sq. yard..	2	10

No.	Sizes.		Granite sets, as described in specification, per square yard, grouted.			Whin sets, as described in specification, per square yard, grouted.			Redressing and relaying old granite and whin sets (belonging to the magistrates and council), as described in specification, per square yard, grouted.		
			With bitumen.			With bitumen.			With bitumen.		
	Breadth.	Depth.	With chips in joints.	With bitumin only.	With cement only.	With chips in joints.	With bitumen only.	With cement only.	With chips in joints.	With bitumen only.	With cement only.
	Inches.	*Inches.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
1	3	5	(*)	(*)	.....	(*)	(*)	.....	2 3	2 4	1 9
2	3	6	11 6	11 7	10 11	8 8	8 9	8 1	2 4	2 5	1 9
3	3	7	12 6	12 7	12 0	9 1	9 2	8 7	2 5	2 6	1 11
4	3	8	(*)	(*)	.....	(*)	(*)	.....	2 6	2 7	2 0
5	3½	5	(*)	(*)	.....	(*)	(*)	.....	2 3	2 4	1 9
6	3½	6	11 6	11 7	10 11	8 8	8 9	8 1	2 4	2 5	1 9
7	3½	7	12 6	12 7	12 0	9 1	9 2	8 7	2 5	2 6	1 11
8	3½	8	(*)	(*)	.....	(*)	(*)	.....	2 6	2 7	2 0
9	3 to 4	5	10 2	10 3	9 7	7 9	7 10	7 2	2 4	2 5	1 9
10	3 to 4	6	10 10	10 11	10 3	8 2	8 3	7 7	2 4	2 5	1 10
11	4 inch cubes....		9 4	9 5	8 10	7 4	7 5	6 10	2 4	2 5	1 11
12	Any size		.....	.....	.....	.....	.....	.....	†1 9	†1 10	†1 2

* Not used at present. † Without redressing.

CHANNEL STONES OR WHEELERS, AS DESCRIBED IN SPECIFICATION.

No.		Grouted with bitumen, 5 to 7 inches deep.		Grouted with cement, 5 to 7 inches deep.	
		Granite.	Whin.	Granite.	Whin.
		s. d.	*s. d.*	*s. d.*	*s. d.*
1	10 inches broad, per lineal foot	1 5½	1 3½	1 4½	1 2½
2	12 inches broad, per lineal foot.....	1 7½	1 5½	1 6½	1 4½
3	13 inches broad, per lineal foot.....	1 7½	1 7½	1 6½	1 6½
4	14 inches broad, per lineal foot.....	1 9½	1 9½	1 8½	1 8½
5	15 inches broad, per lineal foot.....	1 11½	1 11½	1 10½	1 10½

Extra excavation over depths specified, 2 shillings per cubic yard.
New granite referred to in above schedule of rates to be from —— ——.
New whin referred to in above schedule of rates to be from —— ——.
(Name of party tendering to be signed in full) —— ——.
(Address) —— ——.

DISTRICT OF LEITH AND EDINBURGH.

REPORT BY CONSUL WALLACE BRUCE.

Edinburgh and the adjoining seaport, Leith, have two distinct and separate corporations, but, in appearance, they are one large city, bound together and interlaced by their connecting lines of busy com-

munication which extend over a wide area. The population according to latest official estimate is, respectively, Edinburgh, 275,436, and Leith, 80,736; total, 356,172.

The streets and roads within the municipal boundary of Edinburgh are under the superintendence of the town council of said city, and those within the Leith municipality are superintended by the corporation of Leith.

CITY STREETS AND ROADWAYS.

The following statement sets forth the materials used and the methods employed in making the streets and roadways of Edinburgh and Leith, the cost of building and maintenance of same, and other information relative thereto:

(1.) HEAVY TRAFFIC STREETS.

Granite and whinstone paving.—The ground forming the carriageway in Edinburgh streets is excavated to the depth of about 15 inches under the level of the proposed finished surface of the carriageway. A foundation of cement concrete 6 inches thick is then laid down and beat solid, and adjusted to the requisite levels. The concrete is usually composed of small broken stones and cement in the proportions of five measures stones, one measure cement, and two measures fine sand or gravel, the stones being bedded or built on a cushion of sand 1 inch deep, which is laid on the concrete. In Leith the concrete is sometimes formed of broken whinstone, gravel, or ballast and lime, in the proportions of one measure of slacked lime to one measure of broken stone and one of gravel; then over the concrete a layer of sand about 1½ to 2 inches thick is laid down, and upon this sand the paving stones or sets are laid. The paving stones or sets are squared blocks of granite or whinstone, 8 to 14 inches long, 7 inches deep, and generally 4 inches thick. When the paving stones have been laid to the proper lines or levels, and as the work proceeds, the whole surface is grouted, that is, the joints are filled up with lime mortar, composed of one measure of slacked lime to two parts of fine gravel. The whole of the sets are then beaten down about a half inch or three-quarters of an inch with heavy beaters and the surface of the paving adjusted. The curvature of such carriageway is three quarters of an inch or thereby on 3 feet from channels to center.

The cost of streets paved in this way is, for granite, $2.43 to $2.92, and for whinstone, $1.70 to 1.94 per superficial square yard. Granite paving sets cost at the quayside in Leith, including all dues, $5.60 to $6.07 per ton of 2,240 pounds, and 18 cents to 24 cents per ton will lay them on the ground for the pavers. Whinstone sets delivered at works cost $3.16 per ton.

Wood paving.—In Princess street, Edinburgh, a leading thoroughfare of that city, the carriage traffic is very great, and one section or side of

it to the extent of 200 yards is laid with Scotch grown beechwood blocks in place of the granite or whinstone already described, and, so far as experience yet goes, it has given satisfaction during the 2 years it has been in use. But about 16 years ago other streets of Edinburgh were laid with pine or Baltic redwood blocks, and such paving has not proved satisfactory. Some of the wood in those streets was removed after 8 or 10 years' wear, and the streets were repaved with stone. Wood paving is very favorably accepted by shopkeepers and residents, where it is laid on account of the comparative noiselessness of the traffic upon it, but it is not so durable and therefore not so economical as stone. Wood also leads to much more expense in its maintenance. The wood blocks used are of similar dimensions as the stone, namely, about 9 inches long, 7 inches deep, and 3 to 4 inches thick. The manner of laying the wood in Edinburgh streets is the same as that of laying the stone pavement.

The paving of two streets in Leith has been made of pitch pine and redwood. The blocks used were 9 inches long, 6 inches deep, and 3 inches thick, laid upon a foundation of concrete, composed of one part of Portland cement to four parts of ballast or gravel 6 inches in thickness. The wood blocks forming the pavement were placed about a quarter of an inch apart from each other and the interstices filled with liquid bitumen. These cost for pitch pine 9*s.* 6*d.* ($2.31) and for redwood 8*s.* 6*d.* ($2.07) per superficial square yard.

Val de Travers paving.—In one case a street in Leith was paved with Val de Travers compressed rock asphalt 2½ inches thick, laid upon a foundation of Portland cement concrete 9 inches thick. This paving has stood all kinds of traffic for 18 years, and is, even now, in fair condition, and has proved to be a very great sanitary improvement in the locality. The cost of such paving was 15*s.* ($3.65) per superficial square yard, including all excavations, concrete, and paving. It was maintained by the contractors for 3 years after construction free of charge. For 15 years the cost for maintenance was about 2½*d.* (5 cents) per superficial square yard over the whole area paved. This system is, however, better for level streets than for any gradient, as it is too smooth for horses to get sufficiently secure footing.

(2.) MEDIUM TRAFFIC STREETS.

If the foundation or substratum of the carriageway be of a suitable character, such as firm sand or gravel; the concrete is dispensed with, in which case the cost of paving will be reduced by about 48 cents to 54 cents per superficial square yard, or the cost of the concrete and excavations.

(3.) LIGHT TRAFFIC STREETS.

Common whinstone paving.—The mode followed in paving streets wherein there is light traffic in Edinburgh, is as follows (that in more private parts of the city is generally causeway of a commoner class

of whinstone blocks, with less dressing upon them than on the blocks where the traffic is heavy): The ground having been carefully prepared—but without any concrete foundation—such causeway is laid upon it, the joints or interstices in some cases being filled with bitumen or Portland cement grout. The cost of such work is about 97 cents to $1.21 per superficial square yard. Other light traffic or private streets and roads are "macadamized."

Macadamized roads.—Macadamization, or the process of covering roads with broken stone, came into use in Scotland early in the present century, having been invented by John Loudon Macadam, a Scottish surveyor, and his system was so designated after his name. His system was made known in two works, entitled, respectively, A Practical Essay on the Scientific Repair and Preservation of Public Roads and Remarks on the Present State of Road Making. According to Macadam's invention excellent roads were formed by placing in a suitably prepared road layers of broken granite or other hard stone, which became hardened into a solid mass by the traffic passing over them. For this invention he was, in the year 1827, granted a sum of £10,000 ($48,665) by the British Government.

Throughout Edinburgh the process adopted for macadamizing streets or roads having light traffic is, in laying the foundation, to adjust, equalize, and thoroughly beat down and otherwise prepare the bottom ground to the same curvature as the intended finished surface, the rise being from channels or sides to the center of the carriage way of 1 inch on 3 feet or thereby. Then broken whinstone or "road metal," as it is termed, is laid down from 8 to 10 inches deep, the material being blinded—that is, filled up and rolled—with road scrapings. Ordinary scrapings of a macadamized road make the best blind, being of a cementing or binding nature, and this is finished and left smooth for traffic by the application of horse rollers.

The city of Edinburgh possesses a 20-ton steam roller which has been used in preparing macadamized roadways for traffic, but it is found unsuitable. Horse-rollers, varying from 2 to 3 tons, each drawn by two horses, are found more suitable for the purpose.

In the suburban streets and roadways of Edinburgh where "road metal" is used the cost of macadamizing is from 60 cents to 73 cents per superficial square yard.

The first cost of building or constructing and paving those private streets and roadways is assessed upon the proprietors on both sides of the street or way, in proportion to the lineal frontage.

The ordinary public streets of Edinburgh extend 108 miles; private streets and suburban roadways about 20 miles.

Throughout Leith the method of constructing streets or roads for light traffic on Macadam's principle is as follows: The carriageway is excavated to the depth of about 10 inches under the intended surface thereof, and when this has been done a stratum or layer of broken

stones about the size of 4-inch cubes is laid down. Upon this is placed a layer 4 inches deep of broken whinstone, or "metal," as it is usually termed, about 2-inch cubes. Upon this metal is laid a layer of finer metal about the size of a walnut and 2 inches in thickness, and the whole well blended with crushed gravel—a material which is obtained from the stone-breaking machines when making metal. The whole is then rolled and consolidated with a heavy roller. This costs in the first construction about 73 cents per superficial square yard. The principal part of constructing streets is, in the first instance, done by contract. The rate of 73 cents per square yard superficial includes the cost of the water channels and curbing at the sides of roads. The expense of engineering, preparation of plans, superintending, or measuring work, is, however, not in any case included in the rates given, but if such were allowed for, a sum equal to 5 per cent. at least on the cost would require to be added.

(4) MAINTENANCE.

Granite-paved streets.—The cost of maintaining granite-paved streets for the first 10 years after construction is very small, indeed almost nil, and, from that time onwards to a period from 20 to 25 years after construction, the annual cost per yard for maintenance will not exceed 4 cents, and at the end of that time the paving, as a rule, requires renewal, and the material taken from it may be used in paving quiet streets.

Whinstone-paved streets.—The cost of maintaining whinstone-paved streets for the first 5 years after construction is almost nil, but from that time onwards till about 15 years after construction the maintenance may be taken at 4 cents per yard per annum, and when repaved the old material may be broken up and used for repairs of roads, the making of concrete, etc.

Macadamized roads.—With respect to macadamized roads—being those constructed for lighter traffic—the cost of maintenance may be taken at 6 cents per superficial yard per annum, but this rate will no doubt be varied according to circumstances, such as the state of the weather and the amount of traffic.

There are not any of the roads in or immediately around Leith where the traffic may be said to be really light in the sense that there are no vehicles passing over them carrying goods or general merchandise of a heavy character, but, on the contrary, they are all liable to have any kind of traffic, at times, carried over them.

(5) ASSESSMENT OF FIRST COST.

All the streets and roads within the boundary of the city of Edinburgh, both carriageways and footways, are maintained by the magistrates and council out of the municipal assessment of usually 5*d.* (10 cents) per pound ($4.8665) on the rental of the city.

In constructing public streets of any large extent the cost is gener-

ally defrayed by borrowing money on the security of the municipal rates or assessment and repaying the loans in 20 years. In this way the assessment is not so greatly increased and felt. The assessment for maintaining the roads and streets of the town of Leith at present is 4*d.* (8 cents) per pound ($4.8665) on the valued rental, exclusive of the value of the Leith docks, which, by statute, are exempted from assessment for roads and streets.

The cost of the first construction of roads or streets upon lands laid out by the proprietors or owners of same for the erection of dwelling houses or other buildings thereon is paid by such proprietors or owners, or by their tenants or lessees who have acquired such lands, and, if the work of construction be to the satisfaction of the corporation, the maintenance of such roads or streets is thereafter assumed by the corporation, and the expense is paid out of the general assessment for that purpose.

The cost of land upon which the streets or roads above referred to have been formed has in no instance been taken into account in the prices stated for their construction and maintenance.

Subjoined is a statement kindly supplied to me by the city road surveyor, showing the amounts estimated under the several headings for wages, materials, etc., expended on the Edinburgh streets and roads for the current year (from May 15, 1890, to May 15, 1891).

Wages:	
Breaking stones	$1,581.61
Labor on macadamized roads	10,462.98
Labor on causewayed streets	19,320.00
Forming and repairing cesspools	2,043.93
Works on depots	2,919.90
Foot pavements and footpaths	851.64
Public safety	97.33
Total wages	37,277.39
Materials, cartage, etc.:	
Material, macadamized roads	12,166.25
Cartage, macadamized roads	4,379.85
Stone, causewayed streets	5,839.80
Sand and gravel, causewayed streets	4,379.85
Cartage, causewayed streets	6,569.78
Cesspools and channels	2,919.90
Depots, repairs, and furnishings	486.65
Implements and repairs	2.189.92
Public streets, contract work	29,199.00
Improvements	486.65
Private streets	9,733.00
Foot pavements, contract work	26.765,75
Footpaths, gravel and cartage	973.30
Granolithic footpaths, public street	13,626.20
Public safety	973.30
Total materials, etc	120,689.20
Grand total	157,966.59

COUNTRY ROADS OR HIGHWAYS.

The materials used and the methods employed in making and maintaining the country roads within this consular district and other information pertaining to same are as follows:

THE MIDLOTHIAN ROADS.

Edinburghshire, or, as otherwise named, the county of Midlothian, occupies an area of 358 square miles or 229,120 acres. This area, in the management of its roads, is divided into four districts, namely, the Edinburgh suburban, the Lasswade, the Calder, and the Galawater district, each having its board of road trustees, under whose care the roads in the respective districts are maintained and who control the expenditure required upon them.

In this county there have been two methods used in making and maintaining its roads or highways, viz, those of Telford and of Macadam. Briefly stated, the Telford system consisted of a bottoming of large wedge shaped stones set on end, sharp edge uppermost, with a covering of broken "metal" (stones) on the top. That of Macadam consists of a bed of "metal" broken to a uniform size from top to bottom The latter system has been adopted throughout the county of Edinburgh for many years past, and on account of its giving a smoother surface to the road is considered preferable to the Telford system. It is preferred also as avoiding the risk of the large bottoming stones used in the Telford system working up to the top, which, it is said, happens in nearly all roads having pitched or paved foundations. The first cost of macadamizing a road is usually from 60 cents to 70 cents per superficial square yard.

The main lines of roadway throughout the county of Edinburgh are from 25 to 30 feet wide from fence to fence, the greater width being required for roads of much traffic or near the city; and under the "roads and bridges act" of the year 1878 it is ordained that no erection shall be built more than 7 feet high within 25 feet of the center of the roadway. The old parish roads in the county, however, are often not more than 15 feet wide, but these are frequently being made wider where greater traffic or other circumstances require the improvement. The roadways are maintained with whinstone procured in the neighborhood, broken to a uniform size of $2\frac{1}{4}$ inches, and applied according to the amount of traffic.

In the suburban district of the county of Edinburgh the cost of maintenance of macadamized roads, including the footpaths, varies with the traffic upon them. For instance the cost per mile of roadways leading from quarries is as high as $1,313.95 per mile, while the average of other main lines leading from the city into the country is about $369.85 per mile.

The mode of constructing roads known in Great Britain as the Tel-

ford system above mentioned was invented by Thomas Telford, a celebrated Scottish civil engineer, who accomplished much of the improvement in highway communication which was made throughout this island in the beginning of the present century.

In connection with the above reference the following extract from one of Telford's specifications of the manner of constructing a road 30 feet in width by his method may be deemed of value:

Upon the level bed prepared for the road materials a bottom course or layer of stones is to be set by hand in form of a close, firm pavement. The stones set in the middle of the road are to be 7 inches in depth; at 9 feet from the center 5 inches; and at 15 feet 3 inches. They are to be set on their broadest edges lengthwise across the road, and the breadth of the upper edge is not to exceed 4 inches in any case. All the irregularities of the upper part of the said pavement are to be broken off by the hammer, and all the interslices to be filled with stone chips firmly wedged or packed by hand with a light hammer, so that when the whole pavement is finished there shall be a convexity of 4 inches in the breadth of 15 feet from the center.

The middle 18 feet of pavement is to be coated with hard stones to the depth of 6 inches. Four of these 6 inches to be first put on and worked in by carriages and horses, care being taken to rake in the ruts until the surface becomes firm and consolidated, after which the remaining 2 inches are to be put on.

The whole of this stone is to be broken into pieces as nearly cubical as possible, so that the largest piece in its longest dimensions may pass through a ring of 2½ inches inside diameter. The paved spaces on each side of the 18 middle feet are to be coated with broken stones or well-cleaned strong gravel up to the footpath or other boundary of the road, so as to make the whole convexity of the road 6 inches from the center to the sides of it, and the whole of the materials are to be covered with a binding of 1½ inches in depth of good gravel free from clay or earth.

When stones are very hard they never make a very smooth surface. Limestone will make a much smoother surface than whinstone and other harder stones, but they should not for this reason be preferred to harder stones, for these will wear longest, carriages will run lighter over them, and the expense for scraping and repairing will be less. All the soft kinds of stones make heavy roads in wet weather, and in dry weather there will be more friction upon roads made with them, because there will be more dust on their surface.

The breadth of the road which has been described in the foregoing specification of 30 feet is recommended as fully sufficient for any road forming the approach to a very populous city. The confining of a road to this breadth contributes very much to preserve the whole surface of it from side to side in a good state, and to diminish expense. For, when a road is of greater breadth, the scraping and repairing of the excess beyond 30 feet costs annually a considerable sum.

With respect to the convexity of a road, it should be so arranged that it should be slight in the middle. In giving a convexity of 6 inches to a road of 30 feet in breadth, the convexity at 4 feet from the center should be half an inch, at 9 feet, 2 inches, and at 15 feet, 6 inches. This will give the form of a flat ellipse.

Whenever the natural soil is clay, or retentive of water, the pavement acts as an underdrain to carry off any water that may pass through the surface of the road. The component stones of the pavement having broader bases to stand upon than those that are broken small, are not so liable to be pressed into the earth below, particularly where the soil is soft.

Notwithstanding the foregoing apparently plausible reasons in favor of Mr. Telford's system of constructing roads, it has been discontinued in the county of Midlothian for a considerable time, and that of Macadam is preferred. It might be well also to add that in a country of severe

frosts the Telford roadway might be more readily upheaved, from the nature of its construction, than that of Macadam.

The process of macadamizing the county roads is very similar to the process under that name described in the previous section of this report with reference to city or suburban streets and roads.

A brief summary of those accounts of the Midlothian county roads, estimated expenditure for maintenance for year ending May 15, 1891, exhibits the following results:

Suburban district of Edinburgh.

Material, estimated expenditure: Ninety-one roads, extending 108 miles 6 furlongs 9 yards, required 18,537 cubic yards of metal (broken whinstone), which cost from $1.25 to $1.86 per cubic yard, amounting to....		$25,920.88
Material and labor, total estimated expenditure		43,406.70
Deduct amount to be contributed by the city of Edinburgh.....		9,733.00
		33,673.70
Suburban district rental, £234,250 ($1,139,977.62) assessment thereon at 6½*d.* (13 cents) per £1 ($4.8665) yields	$30,874.39	
Allowance from British Government, say	3,406.55	
		34,280.94
Leaving for miscellaneous expenses.....		607.24

Lasswade district.

Material, estimated expenditure: Eighty-one roads, extending 142 miles 6 furlongs 10 yards, required 7,360 cubic yards of metal, which cost from 99 cents to $2.08 per cubic yard, amounting to.....		12,192.60
Material and labor total estimated expenditure		23,746.67
Lasswade district rental, £188,027 ($915,033.40), assessment thereon at 6*d.* (12 cents) per £1 ($4.8665) yields.....	$22,875.83	
Expected allowance from Government.....	1,849.27	
		24,725.10
Leaving for miscellaneous expenses		978.43

Calder district.

Material, estimated expenditure: Eighty-three roads, extending 156 miles 5 furlongs 186 yards, required 7,705 cubic yards of metal, which cost from 97 cents to $1.50 per cubic yard, amounting to.....		10,429.21
Material and labor, total estimated expenditure		19 105.53
Calder district rental, £164,698 ($801,502.81), assessment thereon at 5½*d.* (11 cents) per £1 ($4.8665) yields.....	$18,367.77	
Probable allowance from Government	1,459.95	
		19,827.72
Leaving for miscellaneous expenses.....		722.19

Gala Water district.

Material, estimated expenditure: Seventy-three roads, extending 150 miles 3 furlongs 131 yards, required metal which cost from $1.01 to $1.74 per cubic yard, amounting to		$5,951.56
Material and labor, total estimated expenditure		10,825.33
Gala Water district rental, £83,402 ($405,866.14), assessment thereon at 6*d.* (12 cents) per £1 (4.8665) yields	$10,146.89	
Grant from Government, say	875.97	
		11,022.86
Leaving for miscellaneous expenses		197.53

Galashiels district.

In further illustration of the second section of my report, I beg to submit the following account of the country roads and highways in the neighborhood of Galashiels and other southern portions of this consular district.

The borough of Galashiels has a population of 19,000. The municipality of Galashiels have the management of their streets and roads under a local act, in which it is provided that streets or roads which are to be built upon on both sides must be 40 feet in width between building and building, and those built upon one side only, 25 feet.

Original construction of roads.—The municipal authorities, in terms of the statute, fix the levels of all streets about to be formed with a view to uniformity. The road or street is thereupon formed, and, on the assumption that the total width is to be 40 feet, the road or highway is made 24 feet in width. The bed is excavated to the depth of 6 inches, and raised in the center to the extent of about 4 inches. "Metal" composed of clean hard whinstone and broken so as to pass through a 2½-inch ring, is laid upon the bed 6 inches deep, and finished in a neat and uniform way. Sometimes the metal is blinded with earth so as to facilitate its consolidation. The cost, including the provision of the metal, may be stated at 60 cents per superficial square yard.

Maintenance of roads.—Once every 2 or 3 years a layer of "metal" 3 inches thick is put upon roads where traffic is somewhat heavy, which is usually all that is required for their maintenance. This entails a cost of about 16 cents per superficial yard. A road upon which the traffic is ordinarily light can have 100 yards of its length maintained at a cost of $2.43.

Curbs and sewers.—On each side of the road a curb and sewer are formed for the purpose of conveying rain and other water from the streets. These occupy a space of about 2 feet in width. The curb is composed of a block of clean hard whinstone or granite, measuring in inches 16 by 10 by 5. The sewer is composed of three blocks of the same material. Each block is 8 inches wide and 6 inches deep. The curbstone is placed on its edge next to the footpath, and the sewer stone next to it is laid with a slope of about 3 inches, its upper edge being about 1 inch below the top of the curbstone, while the other two stones

are laid with a slope to the center of the sewer, and in a line with the proposed contour of the road. The various stones are set upon a bed of clean sharp sand or ashes 4 inches deep.

The cost of the original construction may be stated at curbstone 32 cents and sewer 39 cents per lineal foot.

Maintenance of curbs and sewers.—These are maintained by the renewal at the same cost of the parts in disrepair. They usually require no repair for from 10 to 15 years after their construction.

Original construction of footpath.—The footpaths are constructed on both sides of the street and are 6 feet in width and have a fall toward the curb and sewer of three-eighths of an inch to the foot.

There are many methods and different kinds of material that may be employed in the construction of footpaths, but two of these obtain in and around Galashiels; these are:

(1) *Formed with concrete.*—This is most decidedly the preferable method, although the more expensive. The earth is excavated to the depth of 12 inches below the upper edge of the curbstone. Eight and a half inches of this space is filled with rough gravel or clean stones broken to go through a 3-inch ring, solidly beaten down and leveled; then follows a 2-inch layer of concrete composed of four parts of clean washed gravel to one part of best Portland cement, well beaten down; and before it sets the top layer of 1 inch thick is laid. This top layer of concrete is composed of two parts crushed granite to one part best Portland cement, and is finished off straight and smooth. Thin slips of wood are inserted across the footpath every 6 to 8 feet so as to prevent the blocks of concrete being joined. The cost is about $1.09 per superficial yard.

(2) *Causeway or method known as hornizing.*—The bed is excavated as before and the bottom filled with some approved material; then follows a layer 4 inches deep of clean sharp sand or hard ashes, upon which the stones immediately after referred to are set. These stones are clean, hard water or river stones and are placed upon their edges and pounded down with heavy beaters so as to produce a level surface. These stones measure from 1½ to 2 inches thick, from 4 to 5 inches deep, and from 5 to 8 inches long. The cost may be stated at 48 cents per superficial yard. This method is probably the more durable, as in many cases it lasts for 25 years.

Maintenance of footpaths.—This depends upon the traffic, but in ordinary circumstances no repairs would be required for from 15 to 25 years. If any portion of a footpath requires repair it can be done by renewing the only part in question, and, in the case of concrete, the cost would be about 79 cents per superficial yard, as only the top layer would require removal. In the case of the other method it would cost the same as the original work.

WALLACE BRUCE,
UNITED STATES CONSULATE FOR LEITH, *Consul.*
Edinburgh, January 31, 1891.

CONTINENT OF AMERICA.

BRITISH NORTH AMERICA.

THE IMPORTANCE OF HIGHWAYS.

REPORT BY CONSUL TANNER, OF PICTOU, NOVA SCOTIA.

It is my opinion that when all the inquiries of this circular have been compiled it will be found that no known system of road or street construction can be compared with that of the Romans.

These roads, many of which were constructed 300 years before Christ, are good roads to this day. Roads may come and roads may go, but the Roman road endures forever. The prime object of the Roman highways was to facilitate the movements of troops and army transportation and the quick concentration of troops at a given point. The soldier, his helmet and shield, spear, and accouterments have passed away; the republic itself, the result of their prowess and valor, is a thing of the past, a dream; but the highways remain a lasting monument to their skill and civilization, and if modern times have improved on the methods then practiced, but little if any improvement at all can be traced.

Enough can be traced from ancient history to enable us to form a tolerably correct idea of the methods of road and street building adopted by the Romans. The first object sought was shortness between two given points, the commencement and the terminus. A straight line was drawn from point to point and the road was ordered built on this line regardless of valleys, hills, mountains, or other natural obstructions, and that which engineers pronounced impractical, indeed impossible, was accomplished because it was imperative.

This being determined, two ditches on either side of the road to mark the width were dug, and the soil between removed until a solid foundation was reached. This soil was replaced by more solid material well packed and made thoroughly compact, and every precaution taken that the body of the road should be hard and strong.

This strength was made perfect by four layers of material, the lower layer consisting of large flat stones, if convenient; if not, other stones were used, and these were laid in mortar. The next layer was of small stones or coarse concrete; the third of finer concrete, on which was laid stones of several angles joined nicely and solidly together, which was the fourth layer. These four layers constituted a thickness of from 3 to sometimes 7 feet. On a hard, rocky foundation the two under layers were dispensed with.

This pavement extended nearly the entire width of the roadway, which varied from 13 feet to sometimes more than 20 feet in width, according to its importance.

This account is taken principally from a French work on the ruins of Pompeii in my possession.

These are the leading features in Roman road and street paving construction, for one, in my opinion, varies little from the other. A highway should be made as much for pedestrians as for horses and wagons, and I shall treat this subject from this standpoint in my reply to this circular.

REQUISITES OF A GOOD HIGHWAY.

It is shortness from point to point, a good smooth surface, capable of sustaining great weight without becoming muddy, and over which man and beast can pass with comfort and ease. I have given my opinion of how such a roadway may be secured; any further details may be found with minuteness in any first-class encyclopedia, stated with much more clearness than I can state them.

I had the honor several years ago to report upon the subject of highways to the Department (Consular Report No. 24, 1882, p. 488).

This report attracted considerable attention at home and was reproduced and commented upon by nearly all of our leading journals; and some of our legislatures, notably those of Illinois, Georgia, and South Carolina, took up the subject.

I firmly believe that the great hindrance to the prosperity of the farmers of the United States to-day is the lack of good and substantial national, State, and county farm roads.

I do not think that this proposition can be assailed unless it is to be made stronger than my feeble powers can state it.

Wherever such roads have been constructed they have enhanced the value of the farmer's land, and have given increased value to all the products of his labor.

It is a common mistake that the farmer reaps all the benefits from good roads. While it is unquestionably true that the farmer is benefited in a hundred and fifty ways by good roads, in must be borne in mind that anything which benefits the farmer benefits the entire community.

Our farmers have to compete with farmers who have the very best facilities for hauling their product to the markets (at a minimum of labor and cost) and to the railways. Highways in Europe enable the farmer to carry immense loads to the markets with one horse which our farmers can not do in some instances at all, because the road is simply impassable. Our farmers can perceive the odds against them when a dog in Europe can draw a load to the market which a horse can not do in the United States.

This is a day of close competition in everything, and the farmers of

our country are realizing this. They have an immense advantage over the European farmers, and have reduced the latter to the practice of the very strictest economy in order to live at all. With economy and with the advantage of the excellent highways the European farmers eke out an existence, but they have learned by stern necessity that which our farmers must learn for protection.

If a highway can be provided by which a farmer can haul an increased load to the market with one horse that at the present time requires the services of two, with a larger and stronger wagon, and if this can be done in 1 day instead of 3 or 4, it is as palpable as a proposition can be that he is benefited just in that proportion.

How much this proportion is against our farmers will be seen when I state that some of our farm roads are absolutely impassable at certain seasons of the year, and four horses could not draw a load to our markets that one could easily draw to any market in Europe.

The European highways are crowded with pedestrians and with bicycles. This is true because the condition of the roads invite such exercise. In the Valley of Virginia we have an excellent road. During our civil war army wagons, cannons, and the tramp of soldiers which ground into slush a common road left this highway comparatively uninjured. Farms along this road are worth and can readily sell for 100 per cent. more than farms on the ordinary country roads. The farmers are in better condition, and if you were to tell them that you meant to deprive them of their road there would be consternation among them.

There is nothing more rational to my mind than the movement of the farmers towards bettering the condition that environs them. But this question of good highways that the Government will seemingly take up for them, judging from this circular, is a towering mountain before their very eyes, whose top is lost in the heavens compared with a microscopic atom with anything else that affects them. If they are given good roadways depend upon it half of what they complain of will be removed. If railroads may be compared to the arteries of a living body, then wagon roads are the veins, and each are equally necessary in quickening and in communicating life to the parts to which they lead.

From this circular I believe our Government is sensible of this obligation which we owe our farmers, and which our interest and civilization imperatively demand that we should pay them.

More than three hundred years before Christ the Romans recognized the importance of good highways and they saw that this was a subject of the very first importance to them. Historians have looked only to battles and the clash of arms and the great and stirring events in the epochs of nations, and have attributed this cause and that cause as contributing to the national puissance; but, in my opinion, nothing was more of a factor in Roman conquests than the splendid roadways that allowed her troops to be concentrated quickly and hurled with force on the enemy.

More than one hundred years ago English farmers arose and demanded good roads, and they continued to demand them until they got them.

There is not a state in Europe but has had good roadways for at least a hundred years.

We are then at least one hundred years behind Europe, and about twenty-four hundred years behind Rome in this important matter.

There is not a question but that we must have good highways.

Our Government owes this to the people; and believing this as firmly as I do, I have sketched out on a map,* which I have the honor to forward in this report, seven different routes of national highways.

I have adopted the Roman plan of drawing a straight line from point to point; and this, in my opinion, should be strictly adhered to in any system of highways we may build. Influence should not be allowed to twist, turn, distort, and crook such highways.

The first grand route, as will be seen from the map, is a direct one from Danforth, on the Maine frontier, to St. Louis, thence to San Francisco. This route should be the great national highway, and it should be 50 feet wide, with a row of shade trees on either side and one in the middle of the road, with watering places with fresh running water every 5 miles along the route.

The next route in importance on the map is that from Bangor, Me., via Portland, Boston, Providence, Hartford, New York, Philadelphia, Washington, Spartanburg, Atlanta, Montgomery, and New Orleans.

The next in importance will be from New York or Philadelphia direct to Cincinnati, Louisville, Memphis, Austin, and thence to the Mexican frontier at Ivias. The next grand route will be seen to be from Chicago direct to Salt Lake City, thence to San Francisco.

The next from Chicago to Cincinnati, thence to Wilmington. The next from Duluth to Helena, thence to Tacoma, thence to San Francisco, thence to Yumas.

The red lines indicate connecting routes of minor importance which should be built by the States or Territories through which they run.

I will not go to the trouble of defending, advocating, or championing this system. I will allow the plan as drawn to speak for itself. If we want our country settled up we should offer facilities for people to get to it in their wagons and on foot as well as by rail. Good roads is the best invitation for people to settle a country, and our enlightenment and civilization demand of us to furnish this means of communication, circulation, and exchange of products.

Convicts and paupers could not be better employed than in building and keeping up State highways, and this, it seems to me, would be the best and most practical employment for them.

Lord Macaulay attributes the wretched condition of the English highways at the beginning of the eighteenth century as "due to the

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* Map not printed.

state of the law, which compelled each parish to maintain its own roads with statute labor." As this is the system principally in vogue in the United States, this may also be the reason of our bad roads.

The money expended on many of our good for nothing mud roads is absolutely thrown away. If we want good roads we must go to work and make them good, and then it is easy to keep them good; whereas if they are bad to commence with all the money spent on them is just the same as throwing it to the dogs. One hundred millions of dollars spent in making a first-class road saves two hundred millions in dribbles on roads that remain bad in spite of all amounts expended on them.

GEO. C. TANNER,
Consul.

UNITED STATES CONSULATE,
Pictou, November 29, 1890.

DOMINION OF CANADA.

BELLEVILLE.

REPORT BY CONSUL DENEEN.

I have the honor to make the following report concerning the streets of Belleville and the roads of Hastings County, Ontario, Canada.

The ground on which the city of Belleville is built rests on a limestone formation. In many places the stone crops out on the surface. There are 38 miles of streets in Belleville. To make them limestone broken by a crusher is employed. This stone costs $4.50 per cord at the crusher. A cord contains 4 cubic yards and 20 cubic feet. The cost per cubic yard therefore is 95 cents, and the cost of drawing and spreading the broken stone on the streets is about 30 cents per yard. Whole cost per cubic yard, $1.25. One cubic yard will suffice for 4 square yards. The cost is therefore 31¼ cents per square yard when the stone is spread on the street. There is a small piece of square stone pavement which cost $2.75 per square yard.

The sidewalks are made of pine planks, except a small piece of square block Nicholson pavement. The plank sidewalks cost 25 cents per square yard; the block pavement $1.10 per square yard. The sum of $9,000 is annually expended in building and repairing streets. It costs $3,500 to build new and repair old sidewalks each year. The remainder, $5,500, is devoted to building and repairing streets, culverts, and drains.

There are between 400 and 500 miles of macadamized roads in Hastings County. The stone of which they are made costs 45 cents a cubic yard. This will suffice for 4 square yards.

For these statistics I am indebted to James Taylor, supervisor of streets.

S. H. DENEEN,
Consul.

UNITED STATES CONSULATE,
Belleville, December 4, 1890.

BRITISH COLUMBIA.

REPORT BY CONSUL MYERS, OF VICTORIA.

Considering the recent date of settlement, the rough and uneven character of the surface of the country, and the limited finances at command, this province is remarkable, in the older portions especially, for its excellent roadways, and in all parts of it for the interest taken in them and for the amount of money expended in their construction. This has been brought about, first, by the necessity here for artificial roadways; second, by the abundance and variety of good material for roadmaking; third, by the good examples early set by the Hudson's Bay Company; fourth, by the Scotch taste, energy, and skill that dominate largely in governmental affairs in this province.

I have been unable to ascertain the exact per cent. of the total revenues of the province put into roads each year, but it must be a very high rate, and it has required courage to make such an expenditure of money. The total receipts of the province are less than $1,000,000 per annum, yet out of this meager resource and where the surface of the country is broken everywhere with rocky hills and narrow valleys, covered by a dense growth of Douglas and other firs, and further obstructed by dense underbrush, etc., fine roads wind everywhere, and in the vicinity of Victoria and the chief towns of the mainland they are the delight of tourists, and are among the principal agencies in opening up otherwise inaccessible forests and mines. How has this been accomplished?

COUNTRY ROADS.

In the first place and chiefly the provincial government has entire charge of all road work. I emphasize this point because, in my judgment, it is the key to the success of the system that prevails here. Road work is not left to local caprice, nor is it placed in the hands of incompetent or inexperienced persons. The department of lands and works determines where a road is needed, and then it is laid out by a competent engineer, and thus the roads of the entire province are related to one another. The government not only determines where the road shall be, but how it is to be made, who is to make it and what the cost shall be; and then it pays the bill out of the public treasury. There is no special tax or special road appropriation. The work of construction is under the supervision of competent civil engineers and foremen who have what may be regarded as liberal salaries. The latter receive from $100 to $150 per month. All work is done thoroughly and with great system, and the work of one year is the foundation for the work of the following year, according to the general plan of improvements.

There are two methods of prosecuting these public works. One is by contract, based on carefully prepared specifications. Roads are generally constructed in this way. The other method is by day labor, under the supervision of a government foreman, who is appointed by the department of public works.

Roads are divided into four classes, first, second, third, and fourth. A first-class country road may be described as follows: In width it is from 18 to 20 feet between ditches. In making it the trees and shrubs are first cut away in a strip 30 to 40 feet wide. The ground is then grubbed, and finally it is graded to a uniform surface, being crowned in cross-section 12 to 18 inches in the center. It is then paved with suitable crushed stone to a depth of not less than 6 inches, and it may be 9 or 12 inches. The width of this macadam is 12 to 15 feet. Over the top of this stone is spread a layer of good, coarse gravel to a depth of 6 to 12 inches.

Such a road costs from $3,000 to $5,000 per mile, owing to the size of the trees to be removed, the amount of grading and blasting, and the convenience of stone and gravel. The road from Victoria to Esquimalt Harbor, which is a little over 3 miles long, was macadamized at a cost of $4,000 per mile, but there was extra good work put upon it. In this vicinity the ordinary cost of earth excavation is 30 cents per cubic yard, and of rock excavation $2.75 per cubic yard.

Second-class roads are simply cleared of the trees, grubbed, and graded, and are usually about 20 feet wide in the clearing and 10 to 12 in the grading. They are not regularly macademized or graveled, and the cost is from $500 to $1,000 per mile.

Third-class roads are forest cleared and stumps close chopped, without further work. They cost from $200 to $500 per mile.

A trail is intended for pack animals only. The principal work done is to cut off trees and bushes a few feet in width through the forest, and blast pathways along the sides of precipitous hills and mountains.

The Government makes all the principal trunk lines and nearly all of the branches. It also owns and operates steam machinery, drills, and rock-crushers. Where rock and gravel are not available, corduroy, plank, etc., are employed. Roads in use are kept in repair by annual appropriations.

The following table will show the number of miles of each grade of road in the different districts:

District.	First class.	Second class.	Third class.	Trail.
	Miles.	*Miles.*	*Miles.*	*Miles.*
Victoria	61	21	15	.....
Esquimalt	34	22	12	.....
Cowichan	26	49	27	.....
Nanaimo	66	54	44	39
New Westminster	228	127	50	.....
Yale	467	151	61	300
Scillvoet	204	121	52	.....
Cariboo	162	32	.....	947

No distinction is made as to roads for heavy or light traffic. All the roads are used for all purposes required by the convenience of the people. In building rock is usually abundant, often a part of the excavation, and beds of gravel suitable abound in all parts of the province. If wood is required, such as poles for corduroy, or even plank, the supply is almost limitless.

These artificial roads add greatly to the value of adjacent lands and make settlements possible where without them men could not live.

CITY STREETS.

The streets and sidewalks of all incorporated towns and cities are constructed by the corporation, and are paid for by it, and the general plan of work is the same as that on first-class roads. The trees are removed, the ground grubbed and graded. It is then macadamized to a depth of 8 or 10 inches. Gravel is also used. The price of earth and rock excavations is about the same as in country districts. The cost of macadamizing 8 inches deep in Victoria is 65 cents per square yard. There are about 60 miles of graded streets in Victoria, forty of which are macadamized.

LEVI W. MYERS,
Consul.

UNITED STATES CONSULATE,
Victoria, December 16, 1890.

CHATHAM.

REPORT BY COMMERCIAL AGENT WEBSTER.

The roads in Chatham are made of stone, cedar blocks, and brick. The methods are as follows: Limestone set on a bed of sand 10 inches in depth has been in constant use for 30 years, its cost $1.25 per square yard for material and labor; round cedar block pavement on a bed of sand 7 inches in depth, cost 85 cents per square yard; its durability is 6 years. Brick paving is a new branch here; it is supposed to last from 10 to 15 years; it is made first as follows: A bed of fine gravel 7 inches thick rolled with a 6-ton roller, on which is laid one layer of brick on the sides; on them is spread 2 inches of sand, then one layer of brick on edge, after which roll all with a 6-ton roller; cost, $1 per square yard.

The best brick is made from iron slack, and is equal to granite, but most of the brick is made from ordinary top clay. I will add that this town took this pavement from Alliance, Ohio, where it is giving good satisfaction.

I am, sir,

W. H. H WEBSTER,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Chatham, January 6, 1891.

COATICOOK.

Owing to the primitive and ancient methods of building and maintaining roadways here there is positively nothing to learn. I have to inform you, however, that since the recent introduction of American road machines the public highways have been very much improved by their use.

ALFRED W. STREET,
United States Consul.

UNITED STATES CONSULATE,
Coaticook, January 2, 1891.

MONCTON.

There is neither street-building nor road-making in any part of my district; simply ordinary country roads.

The city council at Moncton are now considering the advisability of paving the main street, but it is impossible to say when such will be carried into effect.

JAMES S. BENEDICT,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Moncton, New Brunswick, December 11, 1890.

KINGSTON.

REPORT BY CONSUL TWITCHELL.

I have the honor to submit the following report. The report upon city streets is almost entirely the work of George Osborne, esq., one of the city aldermen, who is giving great attention to the improvement of city streets. The information of the public highways was furnished by Thomas Dawson, esq., for many years of the county council.

CITY STREETS.

The streets within the limits of the city are supposed to be macadam. Broken limestone forms the upper stratum of 8½ inches; some kind of rotten soft stone, here called binding, is then spread thinly over the surface, then the whole is rolled in with a heavy steam roller. When finished and as long as the weather is dry the streets are fairly good, but on the approach of wet weather the lack of stability is evident, and false economy is shown by the accumulation of mud formed on the wearing surface. Then again the underlying stones sink into the ground, causing holes to be formed; these holes hold water, the result being the road soon wears out and has to be constantly renewed. In

the first place, according to the best authorities, limestone is unfit to use on streets, because of its soft nature, but it is cheaper than any other stone to crush, and is also cheaper to roll, but the cost of repairing is frequent and great. The constant renewals and the abundant and excessive sprinkling, made necessary on account of the dust, tax the purse beyond endurance. Added to this the dust from the limestone streets is most unhealthy, as we must to some extent take it into our lungs in dry weather and we breathe its emanations in wet weather. During this year small portions of the city streets have, as an experiment, had a covering of granite chips spread over them about 4 or 5 inches deep and rolled in. How this will last can not be judged until next year.

The quantities needed for laying down limestone macadam and the cost in this vicinity are as follows:

On a block 264 feet long by 35 feet wide:

Rough stone, about 8½ inches deep, 30 tons, at $4	$120.00
Gravel, 3 inches deep, 11 tons, at $6	66.00
Binding (rotten soft stone), 7 tons, at $4	28.00
Spreading stone	25.00
Rolling	25.00
Total	264.00

Or 24 cents per square rod.

The quantities needed for laying down granite macadam and cost of doing same are as follows:

Rough limestone, 8½ inches deep, 30 tons, at $4	$120.00
Granite chips, 5 inches deep, 18 tons, at $12	216.00
Binding (rotten soft stone), 7 tons, at $4	28.00
Rolling and spreading	50.00
Total	414.00

Or 39 cents per square yard.

The conclusion to be drawn from the above facts is that limestone for streets is not good. The binding is worse than useless, as it all has to be scraped off in wet weather or is left on the streets as mud. No opinion can be expressed on the value of granite chips, as the experiment is only in its initial stage. Street building and repairing is under the direction of the city engineer, controlled by the city council. The expenses are paid from the city treasury.

COUNTRY HIGHWAYS.

In the province of Ontario the government in surveying new townships, establish the principal roads, known as concessions and base lines, and subsequently open up and construct roads leading from the older settlements, known as colonization roads. This work is provided for from a fund known as a colonization fund, set aside by the provincial or state government and drawn from the provincial exchequer. This fund appears in the estimates of the annual budget. Such work is usually performed under the supervision of overseers appointed by the depart-

ment, and is strictly a government work. Subsequently, as the township progresses from a colonization state, the roads come under the municipal control and are thenceforward opened up and kept in repair by statute labor, being in proportion to the assessed value of property, the number of days' labor according to assessed value, however, being fixed by statute law, and is not less than 50 cents or more than $1 per day, to be regulated by local municipalities. There is also what is known as a poll tax, which is an imposition of two days' labor upon all males between the ages of 21 and 60, respectively. This, however, is superseeded when a party becomes assessed. In many cases local municipalities have given to private companies the right to build macadamized roads and draw tolls therefrom. This system is a relic of a bygone age and is fast disappearing. Each local municipality strikes in their estimates a certain sum for roads and bridges, to provide planking for bridges, dig and construct particular culverts, or other extreme repairs which may arise from time to time.

M. H. TWITCHELL,
Consul.

UNITED STATES CONSULATE,
Kingston, December 23, 1890.

MONTREAL.

REPORT BY CONSUL-GENERAL KNAPP.

CARE AND MAINTENANCE.

The establishment, care, and maintenance of the streets of the city of Montreal are under the supervision and control of the mayor and board of aldermen of the city.

A subcommittee of the board numbering seven aldermen compose what is termed the road committee. This committee has the special supervision of the road department, at the head of which is the city surveyor. But while the said committee has special supervision of that department, still the mayor and board of aldermen have the general supervision and control of that department and of all matters relating to the establishment, care, and maintenance of the streets of the city.

The city of Montreal has for 2 years last past spent and is still spending large sums of money in the improvement of her streets.

During the year 1890 nearly $460,000 was spent in repaving certain streets, and for this purpose there was used four kinds of pavements, namely: "The wood-block pavement," "the block-stone pavement," "the Trinidad asphalt pavement," and "the Sicilian rock asphalt pavement."

The manner of laying each of the above kind of pavements and the cost of the same were in detail as follows:

WOOD-BLOCK PAVEMENT.

The blocks used for this pavement were the Tamarac blocks, live wood, sawed on all faces, made from 3-inch plank of the following dimensions, viz: 3 inches thick, 5 inches wide, and 6 inches deep.

The foundation for these blocks was made by excavating the subsoil and other matter to a sufficient depth and making a solid foundation.

Upon this foundation there was laid Portland cement concrete 6 inches thick.

The concrete was of the following proportions: One measure of Portland cement, 3 measures of clean, sharp river sand, and 8 measures of broken stone or macadam, which was new and broken to $2\frac{1}{2}$-inch cubes, and was made and mixed as follows: One measure of cement and 3 of sand, mixed dry, and then made into a mortar with 20 per cent. of water; 8 measures of new broken stone was then immediately incorporated with the mortar, and rapidly mixed, and spread and thoroughly compacted by ramming gently with a wooden rammer (about 9 inches square), until free mortar appears upon the surface, which must be perfectly smooth and cambered to the same level as the finished road surface. This was allowed to remain 7 days before the paving blocks were placed upon it.

Upon this foundation the wood paving blocks, creosoted, were laid close together and on the surface a coating of hot coal tar and pitch was poured until the blocks would absorb no more; over this a coating of fine roofing gravel about 1 inch in thickness was spread.

There was during the year 1890 40,471$\frac{1}{2}$ square yards of this pavement laid in all, at a total cost of $120,486. Of this 26,243 square yards was laid by contract work, at an aggragate cost of $80,512, or an average cost of about 3.06\frac{3}{4}$ per square yard, and 14,228$\frac{1}{2}$ square yards by day work, at an aggregate cost of $39,974, or an average cost of about $2.81 per square yard.

BLOCK-STONE PAVEMENT.

The paving blocks used in this kind of pavement were of granite and Belgium porphyry, in length from 8 to 14 inches, in width from 3 to $4\frac{1}{2}$ inches, all being of a uniform depth of 6 inches.

The foundation for these blocks was made by excavating the soil for a sufficient depth and making a solid foundation.

Upon that foundation was laid Portland cement concrete 6 inches thick. The concrete was of the same preparation as that used for the wood-block pavement above described. On this was laid a bed of clean, sharp river sand 2 inches thick. Upon this foundation the stone blocks were laid. Each row of block stone were of uniform width and depth, and so laid that all longitudinal joints were broken by a lap of

at least 2 inches, and the joints not more than half an inch. The blocks were then consolidated by ramming until they were in a firm, unyielding bed, with uniform surface, and when thus laid the joints were immediately filled with cement grout until the sand beneath the blocks absorbed no more and the joints filled flush with the surface of the pavement. The whole surface of the pavement was covered with clean, sharp river sand to a depth of 1 inch.

There was laid during the year 1890 32831 square yards, or 1¼ miles, of this pavement, at an aggregate cost of $133,722, or an average cost of $4.07⅓ per square yard.

ROCK ASPHALT PAVEMENTS.

The foundations for these pavements was made of the same depth, the same materials, and in the same way as the foundation for the wood-block pavement above described, to which reference is hereby made. Upon such foundation the paving asphalt was carefully spread in such a manner as to give uniform and regular grade and thickness, the wearing asphalt surface being 2½ inches thick when compressed.

Of these pavements there was laid during the year 1890 30,619 square yards, viz: Of the Trinidad asphalt 8,147 square yards, or one-third of a mile, at an aggregate cost of $27,954, or an average cost of $3.43 per square yard; of the Sicilian rock asphalt 22,472 square yards, or 1 mile, at an aggregate cost of $89,213, or an average cost of $3.97 per square yard.

Of the above-mentioned pavements the block-stone pavement is considered best for heavy traffic, while the asphalt is considered best for light traffic.

The cost of paving the streets of Montreal is paid by the city and not assessed against the property on the streets.

The cost of the above-described paving was paid by a loan negotiated by the city, and no part of the same was levied against the property adjacent to the streets so paved.

The cost of paving and maintaining the streets and roads of Montreal during the year 1890 was as follows:

Paving	$459,437
Cleaning	52,864
Removal of snow	17,557
Repairing	99,641
Watering	15,745

It may be proper to add that the city of Montreal is spending and contemplates the further expenditure of large sums of money in widening, paving, and otherwise improving its streets and roads in a manner most enterprising and creditable to the city.

Permit me to add that this report is confined to city streets, for the reason that the country roads in the province of Quebec embrace many road districts, each under local management. The maintenance

of these roads and the cost of the same depend upon the climate, the soil, and the requirements of traffic in each, and as I am informed that the same circular of inquiry has been forwarded to the several consular officers in the province, it is assumed that they will forward to the Department full and complete reports, being in possession of more detailed and accurate information as to the roads in their respective localities than is this consulate-general.

All of which is respectfully submitted.

CHAS. L. KNAPP,
Consul-General.

UNITED STATES CONSULATE-GENERAL.
Montreal, March, 9, 1891.

MORRISBURG.

REPORT BY COMMERCIAL AGENT SCHOFIELD.

MACADAMIZED COUNTRY ROADS.

I have talked with a number of farmers from different sections of my consular district as to the best kind of roads for the country, the mode of making them last longest, and the way they are kept in repair, etc., and they all agree that macadamizing made as follows is the most suitable for this section of country:

First prepare the place where the road is to be made, say 12, 18, or more feet wide, as may be required; then put on 12 inches at least of stone in the center of the road and 6 inches on the sides. The travel will be in the center of the road. The stone to be made fine by a crusher not larger than will pass through a 2-inch ring. Then cover with fine gravel or coarse sand, if the same can be had. This will help to cement the stones together and make them even, hard, and dry. Then there must be good deep ditches on each side of the road, to let the water pass off and keep the road dry. As the stone settles in the dirt put on more stones to prevent holes in the road.

EXPENSE OF ROADMAKING.

The first cost is, say, from $6 to $8 per rod. Sometimes, in a bad place, it will cost more.

Some of the roads are kept in repair by money from toll-gates, some by the statute labor of the parties living along the road, some by a tax on the county, some in one way and another as the different townships may see fit.

GENERAL EFFECTS OF GOOD ROADWAYS.

Good roads are a great benefit to any country and enhance the value of the land. They give the inhabitants at all seasons of the year the benefit of going to market to sell their produce and get their supplies. In

good sections of the country villages are built up, manufactories in a small way started, stores, post-offices, schools, and other public buildings erected, and when they have a water-power mills are built. This benefits the inhabitants, the country improves, travel is opened. All this from good roads. Without them a country will not improve much.

TOWN AND VILLAGE STREETS.

In towns and villages the public traveled roads are made as in the country. The sidewalks are mostly built of wood, as follows: Prepare the ground, say 4 to 12 feet wide, as may be required; then lay some stringers 12, 18, or more feet long, 4 to 8 or 10 inches square, to keep the covering from the ground; then put on 2-inch deal plank and nail to the stringers. In some places flag stones are used and in other places gravel, but in this section of the country plank is mostly used. Good ditches must be opened on the sides of the roads to let the water pass off so as to keep the planks dry. Where it can be done deep underground sluices are made to let the water off. These streets are properly made and kept in repair by a tax laid on the inhabitants of the towns or villages.

W. A. SCHOFIELD,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Marisburg, December 29, 1890.

NOVA SCOTIA.

REPORT BY CONSUL-GENERAL FRYE, OF HALIFAX.

Referring to the street and roadway circular of November 8 last, from the Department of State, I have to say in reference to the roads in Nova Scotia that for the most part they have been constructed in a manner similar to that usually employed in the country towns of New England, and are probably in about the same average condition. Within a few years, however, the importance of the subject of building and keeping them in repair has engaged public attention, and the road system of Nova Scotia has materially improved.

STREETS.

The city of Halifax, with its population of 40,000, is the only city or town within the province where the streets are constructed with engineering skill. Generally it is built upon and courses along a continuous range of hillside for a distance of over 2 miles. The principal streets run nearly parallel with its slope and the shore. The cross streets, laid off at right angles to them, ascend with inclinations varying from 1 foot in 10 to 1 in 15. In the suburbs the gradients are much less, the ground in some directions being nearly level. The cost of maintaining the streets where

the gradients are so steep is greatly increased. The rainfalls wash away the binding materials. The wear from horses, feet increases according to the power required for hauling. Even when well constructed such streets require to be often repaired.

The Macadam system of street making is that generally adopted. It is partly founded on a clay-slate rock in situ, partly on a substratum of broken slate and in some instances the "Telford" bottoming pavement is introduced. The Macadam system is considered the best for the steep gradients, for although it is liable to be torn by the horses' feet, it at the same time gives a more reliable foothold than a material likely to wear to a more slippery surface.

For the streets where the surface is more nearly level and the traffic greater the city contemplate the employment of paving. The city engineer recommends porphyry and granite paving in the usual form of dressed cubes, 8 inches by 4½ inches by 6 inches, to be laid on a substratum of concrete. The material for part of these blocks has been contracted for at the following prices: Belgium porphyry blocks, per square yard, $2.08; Nova Scotia granite, from the Shelburn quarry, $1.75. A quantity of each is to be employed to test the comparative merits, and that giving the best satisfaction after trial will be adopted. The ground work is to be prepared and the blocks set in place by "day's work," under the supervision of the city engineer.

The material used for macadamizing consists of a tough quartzite or whinstone, to be had within easy distance of the city at low cost. The stone is broken principally by pauper or convict labor. The poor of the city are thus furnished with employment by the "Poor Association" during the winter when nothing better is offered. Able-bodied convicts in the city prison are also made to perform such work. The city pays the association 7 cents per bushel for the broken stone, and to the city prison 3 cents per bushel. There are nearly 24 bushels in a cubic yard of broken stone. The demand for this broken stone is becoming greater than the supply, and a stone crusher is to be put in operation forthwith.

Very few new streets are being built in the city at the present time. Repairs are made by "day's work." The wages paid for such labor is from $1 to $1.10 per day.

In the year 1887–'88 the sum expended on the streets of Halifax was $19,230, and on street cleaning and watering, $12,923. In 1888–'89 the street expenditure was $22,484, and for cleaning and watering, $14,756. This does not include repairs to city property, from $1,500 to $1,700 more in each of those years.

For a great part of the information obtained for this report I am indebted to Martin Murphy, esq., provincial government engineer, an intelligent and efficient officer, who has certain supervision over the construction of roads and bridges in Nova Scotia. Having read some of his published papers on road and bridge building, I was the more de-

sirous of consulting him, and applying to him for certain information on the subject of this report he kindly furnished it in writing. To a considerable extent I have adopted the language used in his written answer to my inquiries.

PUBLIC ROADS.

Following is what he says on the subject of building public roads in Nova Scotia:

Nova Scotia, with a present population of about 460,000, an extreme length of 350 miles, breadth, 120 miles, and an area of 20,907 square miles, is provided as follows: The length of main roads in 1880 was 6,493, and of second-class roads 9,761 miles. Present length of main roads, estimated, 6,800 miles, second-class roads, 10,000 miles. Total, 16,800 miles.

The province is divided into eighteen counties having twenty-four municipalities, six of the counties having two municipalities in each.

In 1879 an act of incorporation conferred on every county and sessional district all the usual municipal governing powers, embracing laying out, construction, and maintenance of roads and bridges, the appropriating and apportioning of road and bridge moneys, employment of statute labor, and the regulation of ferries and public wharves. Since then the municipalities have received an annual appropriation from the government of from $90,000 to $120,000 towards the maintenance of roads and bridges.

In 1883 the old wooden bridges then existing had become so bad that an act authorizing a provincial loan of $500,000 was passed for rebuilding them with more permanent material, such as stone and iron. The reconstruction was carried out by the provincial government. Encouraged by the successful operation and results of this measure, the government provided two further grants of $250,000 each in the years 1885 and 1887, respectively, making an expenditure of $1,000,000 for the building of these bridges in a more substantial form.

In 1889 the roads throughout the province, under the supervision of the municipal councils, had become so bad that * * * it became necessary to make a special appropriation of $300,000 for better construction and repairs. The government took the work in hand, employed more skillful supervision, and effected such improvements on the great roads that in the session of 1890 a further appropriation of $300,000 was granted, to be expended in like manner.

The means available for the construction and maintenance of roads in Nova Scotia are derivable from statute labor and from government appropriation. The former source, although quite a factor if judiciously applied, is becoming almost useless in the hands of municipal authorities. Owing to the limited means at the command of the government for annual grants to roads the question of keeping them in good order becomes one of "how, with limited means, the best and most permanent results can be obtained." With such results in view one must be guided by the locality, the facility of obtaining suitable materials, and the traffic which the road is intended to accommodate. The nearest approach to the solution of this problem will be found by the employment of skillful supervision.

In a published article written by Mr. Murphy not long ago on "Our common roads," in referring to the transverse form of roads, he says:

Engineers differ as to the most advantageous form of cross sections, some recommending a convex curve approaching to the segment of a circle or semi-elipse, whilst others prefer two plains gently sloping towards the side gutters and meeting on the middle of the road by a short connecting convex surface. There are objections to both forms in certain situations. In the former, the convex road they are that the

water will stand in the middle; that carriages will keep in or near the middle and cause undue or excessive wear along one line in order to run on the level and avoid the tendency to overturn near the side ditches. In the latter that if carriages will not run along the center there must be, owing to the transverse inclination or fall from the apex or center towards the gutter, an undue tendency for the carriages or vehicles to slide upon the road surface. Regularity of section and evenness of surface is of much more consequence than the slight difference between curves and straight lines. It is essential that the rain should flow freely off the surface for the proper and economical maintenance of a road. Water standing in ruts or depressions must be avoided; it greatly increases wear, deepens and enlarges hollows, and weakens or destroys the whole crust of the road. Such a cross section should therefore be given as will throw the rain water off quickly, and the necessary inclination to practically effect the purpose must vary with the different material of which the road is composed. We can not have, as in Great Britain, one typical form of road, or method of road-making, because we must adapt ourselves to the materials at hand or within easy distance.

It is necessary to give a somewhat greater convexity to a new road than it is intended to have eventually; the middle consolidates more by the traffic and the surface material is scattered towards the sides, so that however carefully it is rolled or attended to the road will flatten as it consolidates.

Copies of drawings to show the forms of cross sections of roads as proposed by the provincial engineer are herewith submitted. Fig. 1 represents a cross section of Telford pavement, which can be made rapidly, and, with the drainage shown, forms a good road. Fig. 2 is a cross section covered with gravel or broken stone. Fig. 3 is a clay road with a 6-inch gravel covering, 8 to 10 feet in width, with a center drain of stones. Fig. 4 is a clay road with a center drain of poles where stone can not be had. Fig. 5 is a cross section of road over a bog or marsh.

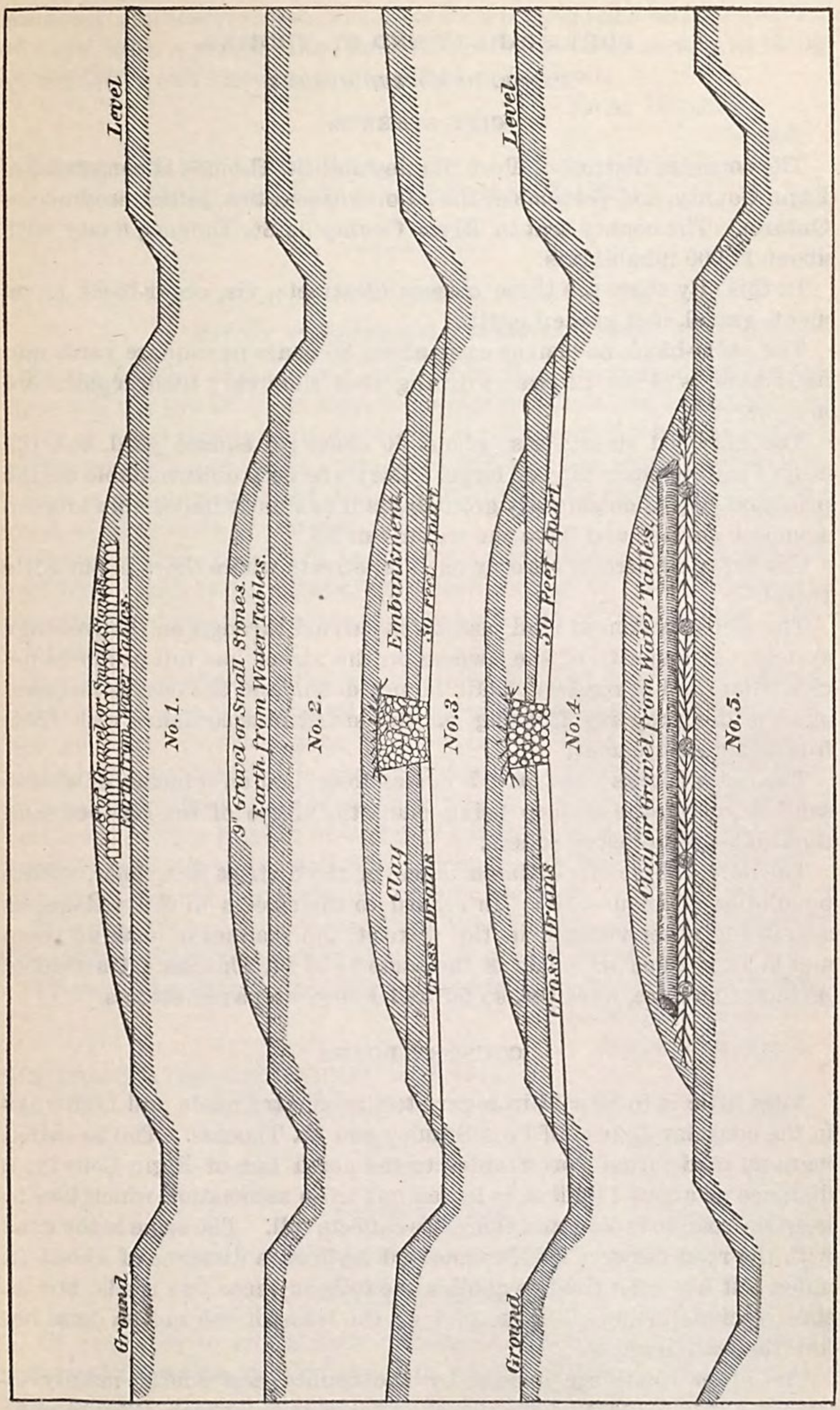
Roads with a drain running along the center, with outlets to the side ditches, have been tried on wet and soft ground, with favorable results

For general purposes, where the traffic is heavy, a well-drained road with the Telford pavement and macadam covering is recommended.

Liberal sums have been expended in bridge building within a few years. Iron bridges in many cases have taken the place of the old wooden structures. Generally the superstructures have been built on American plans, and in several cases American companies have built them on contract. Concrete as a substitute for stone for bridge supports has been used to some extent, and with marked success. The concrete hardens and improves with age, and it is believed that its use will be extended as its merits become better known.

WAKEFIELD G. FRYE,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Halifax, January 27, 1891.


Level.
Ground.
No. 1.
Earth from Water Tables.
Small Stones.
Gravel or Small Stones.
No. 2.
Earth from Water Tables.
Clay
Cross Beams
No. 3.
Embankment.
30 Feet Apart
Level.
Ground.
No. 4.
Cross Beams
30 Feet Apart
Clay or Gravel from Water Tables.
No. 5.

PORT STANLEY AND ST. THOMAS.

REPORT BY CONSUL HUSHER.

CITY STREETS.

The consular district of Port Stanley and St. Thomas is composed of Elgin County, and portions of the adjoining counties, in the province of Ontario. The county seat in Elgin County is St. Thomas, a city with about 11,000 inhabitants.

In this city there are three classes of streets, viz, cedar-block pavement, gravel, and graded earth.

The cedar-block pavement costs about 85 cents per square yard, and its lifetime is about 12 years; during that time very little repairs are necessary.

The graveled streets cost about 50 cents per square yard, but the cost of maintenance is very large. They are very objectionable on the principal streets on sanitary grounds, as it is almost impossible to keep a smooth surface and have the water run off.

Graded earth streets are only used for streets where there is but little travel.

The whole system of road making is carried through on the frontage system. A majority of the owners on the street has full power to decide what kind of roadway shall be put down, and the cost is assessed against the property fronting on the street in accordance with their frontage measurement.

The cedar blocks used are 7 inches long, laid on 6 inches of coarse sand or gravel, the surface being made the shape of the roadbed and then rolled with heavy rollers.

The only village of any importance in the district is Aylmer, with a population of about 1,100. In regard to the streets in this village, as also in the other villages in the district, the manner of making them and holding them in repair is the same as in St. Thomas. Outside of Aylmer there are, however, so far as I know, no paved streets.

COUNTRY ROADS.

Very little is to be said in regard to the country roads and highways in the consular district of Port Stanley and St. Thomas. The so-called "gravel road" from Port Stanley to the north line of Elgin County, a distance of about 13 miles, is leased out to an association which has to keep the road in repair, and therefore collects toll. The same is the case with the road between St. Thomas and Aylmer, a distance of about 12 miles. It has been tried to abolish the tolls on these two roads, but as the association is unwilling to give up the lease, it can not be done before the lease expires.

The other roads are opened by the county, and consist mainly of graded earth roads, in some places covered with gravel. The repairs

are done by statutory work, viz, each farm is assessed a certain number of days' work a year on the road. The work consists mainly in filling up mudholes and smoothing the surface of the road..

F. A. HUSHER,
Consul.

UNITED STATES CONSULATE,
Port Stanley and St. Thomas, December 22, 1890.

PORT HOPE.

REPORT BY COMMERCIAL AGENT SHAFFER.

In the district immediately covered by this commercial agency the streets in the towns are in some instances macadamized, but in the majority of cases simply built up of gravel. These are generally scraped with a road scraper in the spring and fall, and the result is that even with a minimum amount of drainage facilities the roads are generally good at all seasons of the year.

There are some block and asphalt pavements but not over large areas and only in the large cities of the province, and in these this class of pavement is not considered a success by reason of the severity of the winters.

In the rural districts the roads are built up of gravel put on from year to year, and this generally forms a good road during ordinary average weather. In wet seasons, however, they suffer much from soakage; and as the construction is generally done by "statute labor" it is not as a rule very thoroughly or effectively done. Where the soil or ground bed is either very light or of a clayey nature this class of road suffers much in both the spring and fall; in many cases when the frost is going out of the ground the roads are quite impassable.

It is almost impossible to ascertain the average cost of constructing the roads built as they are in the way above indicated.

There are no cities within this commercial agency, except by courtesy.

L. M. SHAFFER,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Port Hope, December 31, 1890.

PORT SARNIA.

REPORT BY CONSUL PAGE.

CITY STREETS.

In reference to city streets nothing in the way of novelty can be reported from this or other cities in western Ontario. We have here the ordinary wooden pavement made by standing cedar blocks on end

and filling the interstices with sand and gravel; formerly a coating of hot tar was applied to the blocks before introducing the gravel; now the tar is generally omitted; latterly in putting down these pavements the excavation made to receive the blocks is first covered with white pine boards, closely joined together. This plan is doubtless an improvement over the former method of placing the blocks upon sand merely. The subject of street paving receives considerable attention just now in this country, and different methods are being tested. An experiment was tried in this town about a year ago in the endeavor to introduce the "asphalt" pavement. This process consisted first in a layer of broken stone or cobblestone, a coating of hot tar, then a coating of fine gravel, and finally a coating of a combination of "asphalt" and sand, applied hot; this last coating is heavily pressed by a large heated iron roller. I witnessed the construction of one such pavement, which has now been laid about 14 months, and its present condition is not such as would impress one favorably with this method. The cobblestones remain almost entirely denuded of the coating of asphalt and sand to which they were originally subjected. This pavement may have been improperly constructed, or possibly the material forming the combination of "asphalt" and sand may have been improperly mixed; whatever may have been the cause, it is apparent the result in this particular case is a failure. Cedar pavements in this climate when properly laid endure about 10 years, yet many of the blocks require to be replaced at the end of 7 or 8 years; much of course depends upon the quality of the cedar used, and great care should be observed in selecting the lumber upon which the blocks are made to rest. If the material is sound and free from what is known as sap, a cedar pavement, properly constructed, ought to last 10 years and even more.

COUNTRY ROADS.

The country roads of Ontario and especially in the older settled portions of the province are really very excellent roads. Their manner of construction is simple, although it differs somewhat in the different localities. In the vicinity of stone quarries broken stone or the refuse from the quarry is used as the first layer in constructing a roadbed; this material is thoroughly pounded into the earth and coarse sand and gravel are added, making a mass several inches in thickness. At first the loose sand and gravel is almost impassable for loaded vehicles, but the continued tramping of horses' feet and the frequent pressure which it receives from passing wheels soon renders the roadbed smooth and hard. In localities remote from stone quarries and where cobblestone are not easily obtained, ordinary sand and gravel is the sole material used in forming a road bed. Whatever may be the material used, whether broken stone or cobblestone, with sand and gravel combined, or sand and gravel without the foundation named, it is essential that

the roadway should be properly constructed with reference to grading and ditching or drainage. This is accomplished by excavating deep, flaring ditches at each side of the roadway (where the road passes through level or flat land), and the construction at intervals of wooden or stone culverts or sluiceways, in order that the surplus water may be turned aside or conducted away from the roadbed. When broken stone or cobblestone is used as a foundation an excavation is made in the center of the roadway, between the two ditches, to the depth of several inches and as wide as may be required to build the road; this excavation is filled with broken stone or cobblestone, in the manner before described, with the addition of sand and gravel, and when the roadbed is completed it shows gradually sloping sides from the center each way to the ditches on the margin of the road.

In many instances very durable and substantial roads are constructed without the use of broken stone or cobblestone, and these roads are built in the easiest and simplest manner possible. No excavation is made in the center of the road to receive the material; the sand and gravel are applied to the surface of the road without preparation precisely as they leave the gravel pit; the gravel is strewn over the surface to the depth of from 4 to 6 inches. The ditches and culverts and even the grading should be as carefully constructed in this method as the other; but it will be readily seen that this process of road building is much cheaper, both in material and labor, than if cobblestone or broken stone are used as a foundation. The loose sand and gravel thus spread over the surface of the road soon becomes hardened and smooth by the tramp of horses' feet and the continued passing of vehicles; a new coating of gravel is applied each year for a few years, and thus the hollow places become filled and the roadbed itself becomes more solidified. In fact, roads built after this method and properly cared for soon become practically indestructible. During the first 2 or 3 years after the gravel is applied hollow places will appear here and there, in the roadway, occasioned perhaps by the more yielding quality of the earth in some spots than in others. These hollow places are filled with a fresh supply of gravel, perhaps once each year, until the whole roadway assumes an unyielding surface, as firm and as smooth as the neighboring rocks. Whilst driving over these magnificent country roads, observing their solidity and comparative cheapness of construction, I have often thought our city street-pavers might learn useful lessons in the art of road building from these unpretentious tillers of the soil.

SAM'L D. PAGE.

UNITED STATES CONSULATE,
Port Sarnia, January 15, 1891.

QUEBEC.

REPORT BY CONSUL RYDER.

COUNTRY ROADS.

The ordinary country roads throughout the Province of Quebec are not on such an improved scale as to invite favorable comparison with any of our most unfrequented roadways in the United States.

Roads over which there is travel to any great extent are usually "turnpike," and these have been largely absorbed by a "turnpike trust." The stock was eagerly subscribed to, as the investment was considered a deširable one, but such a heavy debt was contracted at the formation of the monopoly that it has been struggling under the load ever since, and has been unable to pay dividends to any extent.

These companies have been, in many instances, subsidized by the provincial government to a considerable amount. It was one of the promises of the present administration, made during the recent campaign, that, in the event of success at the polls, all turnpike roads and toll bridges should be purchased by the Government and made free.

An exit can not be made out of this city without passing through one or more toll gates controlled by this trust, where the fee charged varies from 10 to 25 cents per vehicle for each gate. As a general rule these turnpike roads are very good; they are usually the original roadways made by the Government, which have been acquired by a stock company under charter.

These roads are built much the same as an ordinary macadamized road, being excavated to the depth of 2 feet, and then filled with large stones for about 18 inches, the crevices being filled with smaller stones, then broken stones about the size of walnuts are used to even the surface, and the whole covered with a stone dressing and graded so as to afford sufficient drainage for all surface water to flow toward the ditches on either side. This is thoroughly rolled with an ordinary horse road-roller, weighing about 4,000 pounds. After properly constructing these roads there is a very small outlay for repairs, as the travel is not of a heavy class of teams, excepting during the harvest season. The cost of building turnpike roads after this plan is about $1.25 per square yard.

CITY STREETS.

The streets in this city are of two distinct classes, and may be styled the "ancient" and the "modern." The former are located in the older portion of the city, called the "lower town." These are planked with 3-inch pine deals laid lengthwise, and are very narrow, the entire width (both for carriage and foot travel) being from 8 to 12 feet. Where there is a footwalk it is made by placing 3 by 4 pieces, 3 feet long, and covering, with 3-inch pine planks, one side of street only. This style of roadway was decided upon, as there was only surface drainage, and

every refuse was washed to the river over this planking. It is very slippery, and no uncommon sight to see a horse slide on "all fours" for a distance of 25 feet before being able to recover his footing. These pavements are being slowly replaced by stone blocks, and are to be seen only in the most primitive portions of the city.

The upper town is better provided with good roads. The system which has been adopted is open to criticism from a sanitary point of view, and involves much labor and expense. The city engineer has made a special study of the matter of street-paving, and considers this the best adapted to the needs of Quebec, the most durable and also the least expensive.

The street is excavated to the depth of 2 feet, properly graded and rolled with a horse road-roller; then a foundation is made of wooden flooring of 1½-inch boards laid longitudinally and crossed at right angles by a second flooring of inch boards, so as to conform more readily to the required crown of the roadway. These are laid with one-half or three-fourth-inch spaces between, so that should any surface water penetrate it will not remain and freeze, but run through and be absorbed by the subsoil after passing through the layer of sand which is strewn over the flooring to the depth of one-half an inch, which is to prevent the blocks coming in contact with the flooring. This double flooring is the means of distributing the weight of passing loads over an extended area, and also prevents any local settlement of the surface. On the flooring is laid blocks of red tamarack about 12 inches long, as sawn from the log, about 10 to 15 inches in diameter, and placed on end. In the spaces formed around the blocks small pieces of wood are forced, thus filling in and tightening the mass. The interspaces remaining are then filled with a grouting made of sand, cement, and tar, or a mixture of finely-sifted coal ashes and cement. The surface is evenly rolled and covered with sand, which is allowed to remain until every cavity is filled, when the street is swept clean to the blocks.

These roads are very durable; pavements laid 35 years ago were recently taken up, and the tamarack blocks had not shown any signs of decay, but had worn down to about one-half their original length. The surface was as hard as stone. It is said that there is more resistance to this surface (to traffic) than stone, because stone, under the influence of water and the constant teaming, wears away like a grindstone; the vertical pores of the wooden blocks fill with grit, and the fibers of the wood, like the bristles of a brush, sway to and fro with the traffic in opposite directions without breaking.

The blocks are used in their green state, with bark on, which prevents the wood from coming in contact with the filling, and the bark lasts for many years. Great precaution is taken to cut down the tree in proper season, after its sap has all been reduced to fiber and before the spring sap begins its ascension through the pores of the wood.

The cost of this block pavement is from $1.50 to $1.75 per square yard.

FREDERICK M. RYDER,
Consul.

UNITED STATES CONSULATE,
Quebec, Canada, December 22, 1890.

MEXICO.

NORTHERN MEXICO.

REPORT BY CONSUL-GENERAL SUTTON, OF NUEVO LAREDO.

CITY STREETS OF MONTEREY.

The only city in this consular district which has paved streets is that of Monterey, the capital of the State of Nuevo Leon. In that city are some 13 miles of stone pavements. This paving is done by the city, and as much of the work is by convict labor it is not possible to give close approximate values of the cost.

In the better class of this work the process of making is as follows: The ground being leveled, with a slope to the center of the street, coarse gravel is spread over it, and cobblestones averaging, say, 6 inches in diameter are packed in, and more gravel with mortar packed in around to hold them in place. In the center or on the side is a narrow trench to carry off the water from showers. This is often made by laying a long flat stone underneath, with two others, one on each side, on edge, setting up high enough to carry the current. The cobblestones are held in place by setting thin slabs of limestone on edge, and then running at an angle from the center down to the sidewalk. In the climate of Monterey this pavement, when well made, lasts a long time, but from necessity is extremely rough. There is not a paved street in the city of Monterey which is not so rough as to make carriage-riding extremely uncomfortable. Enough of the black soil gets on the stones to make them extremely slippery when wet.

The sidewalks are usually narrow and set 6 to 8 inches above the level of the street. Limestone slabs are set on edge outside, while the sidewalk itself is made of the same stone laid flat, or small cobblestones, or of a sort of mortar called here *tepachil*. The latter is the most durable. It is also much better suited for walking. It is made by preparing a sub-bed of 6 inches of good sized stones with gravel to fill in the interstices; above this a fine sand is laid on and pounded down, and on this a sort of mortar made of fine sand and lime is spread and pounded down. When this is nearly dry it is hand-rubbed with a piece of fine-grained stone until it is water proof and quite smooth.

Most of the houses in Monterey are only one story, and the ground

floor is made largely of this same *tepachil*. I saw recently the floors of one house which were laid of this material more than 30 years ago, had been in use every day, on which no repairs had ever been made, and which are apparently as good as when first made. Water can be freely sprinkled on it, it will hold great weights, and is an admirable floor in all respects, except that it is cold and in damp weather the dampness which rises from it is a fruitful cause of rheumatism and similar diseases.

Sidewalks made of cobblestones have a similar foundation, and the small stones above are mixed and pounded in with mortar. I asked of various persons the cost of sidewalks and floors, and found that the price, always very low, varies from $1 to $3 per square meter, according to the care taken in the work, depth of foundation, etc. In some houses the dirt was removed to the depth of 6 feet, and large stones packed in as closely as possible, and the interstices filled with gravel, and above finely sifted sand. The mortar was more carefully made and pounded and also given more time to dry. There is an abundance of limestone, which splits in good shape for pavements, and labor is so cheap that the prices for the work are very low. I noticed that one of the new smelters has on its main floor this *tepachil* and that it serves its purpose admirably.

There is a great need for smooth streets in Monterey, and the limestone could be laid in small blocks in its native mortar so as to make excellent streets. This *tepachil* floor is used in many portions of northern Mexico. Formerly, flooring could not be obtained, and now it is so expensive that its use is very much restricted.

In this city, Nuevo Laredo, all the paving done consists in leveling the streets and spreading gravel on top. The sidewalks here are of brick or flat stones, or tepachil. Each person makes his own sidewalk, and there are no strict rules enforcing uniformity of height, width, or material. Mostly they are very narrow, rough, and only better than the mud or fine dust.

COUNTRY ROADS OR HIGHWAYS.

The highways of northern Mexico are in a very primitive condition. Owing to the great geographical area and the sparseness of population it has not been possible to expend much money in bridging streams or improving the original condition of the first roads. In the time of the Spanish dominion, considerable was done in making a few main highways from one principal city to another. Until within a very few years little attention has been paid by the Mexican authorities to this very important matter. Streams have been forded and bad places in the roads avoided by going different routes. During the last 6 or 8 years the matter has received more attention, and several of the States in Northern Mexico have made good beginnings on some roads which were most needed. In this work, however, they have been greatly hampered

by lack of funds, as all the available taxes are usually expended for other purposes.

The Federal Government has taken measures to bring this subject to the attention of the State authorities, and while very little has been done, comparatively speaking, and the roads as a whole are in a lamentable condition, yet the public and official mind is fairly awakened to the need of improved roads, and if funds were available the work would be promptly taken in hand. The railways have now reached so many of the principal cities that side roads and roads from mines, haciendas, etc., to railway connections are of special importance.

Owing to the geographical and financial condition, Mexico has a much more valid excuse for the neglect to improve the highways than has the United States. In the latter, especially in the older States, there has been for many years sufficient money, but no educated public sentiment as to the great importance of the work.

Within the last few years several states in northern Mexico have appropriated sums of money to build bridges and repair others and improve portions of the highway. Some municipalities have also made a beginning in this direction. So far, it can not be said that any well-considered system has been adopted and continued in this work.

WARNER P. SUTTON,
Consul-General.

UNITED STATES CONSULATE,
Nuevo Laredo, February 11, 1891.

NOGALES.

REPORT BY CONSUL SMITH.

CITY STREETS.

The materials used for street construction in this place, are the ordinary gravel, rock, and dirt, but no special effort is made to put and keep the streets in repair. This system of construction prevails in all the important towns of this consular district, and as there is but little pleasure driving in these towns, there is but little use for better streets.

COUNTRY ROADS OR HIGHWAYS.

The country roads are all natural highways and for the most part are very good, considering that but little work is done on them. There are now and then bridges crossing streams, but generally the streams are small and are forded. The natural roads of this country are quite noted for their excellence, and for the most of the year are smooth and hard. They usually follow the open cañons and often in making a journey of 20 miles, one encounters nearly every point of the compass,

or in other words, the roads are tortuous, and frequently one travels 4 or 5 miles to make a distance of 2 in an air line.

DELOS H. SMITH,
Consul.

UNITED STATES CONSULATE,
Nogales, December 2, 1890.

PASO DEL NORTE.

No macadamized or paved streets in this city. They are kept in repair by prisoners under the direction of police officers.

No improved public roads in this consular district.

But little work of any kind done on them except by volunteer work, as necessity requires, and by prisoners from the city jail.

A. J. SAMPSON,
Consul.

UNITED STATES CONSULATE,
Paso del Norte, December 3, 1890.

PIEDRAS NEGRAS.

REPORT BY CONSUL FECHÉT.

Within the limits of this consular district, excepting perhaps the city of Parras, there is not a paved street or roadway. In Parras cobblestones were used and at an early date, so that an estimate of cost would be difficult to arrive at. The towns and villages of this district have simple dirt roads, with a footpath at each side, generally made of packed soil. These roads are very dusty or very muddy, according to prevalence of drought or rain.

In the country no attempts are made at road-making, save an occasional bit of turnpike and ditch in low, undrained spots.

Generally it can be stated that, in this consular district, there are no paved streets or maintained country roads, as in the United States, and hence my inability to report anything of value to those desiring information upon the streets and roadways of foreign countries.

EUGENE O. FECHÉT,
Consul.

UNITED STATES CONSULATE,
Piedras Negras, December 23, 1890.

SONORA.

REPORT BY CONSUL WILLARD, OF GUAYMAS.

In this consular district (Sonora) there is but little to report as to the construction of "city streets and country roads or highways which is germane to the subject of improved roads."

CITY STREETS.

The streets of the cities and towns of Sonora can not be said to be expensive to construct or keep in repairs. The cities and town sites, as a rule, are located on level or comparatively level ground, the soil, according to the locality, being of rock, sand, gravel, and clay. In the four important cities of Sonora (Hermosillo, Guaymas, Ures, and Alamos), whose united population will not exceed 50,000 people, there are but few improved streets, and they will not, in the aggregate, exceed 8 miles. The streets that are improved are paved with cobblestones, and flat stones laid in sand, and are not fitted or intended for heavy traffic. As a rule these paved streets are confined around the public squares or parks (generally located in the center of the city) and approaches to the same, suitable for light traffic only; when repairs are needed the city authorities (city council or ayuntamiento) order it done, authorizing the expenditures necessary for the purpose.

COUNTRY ROADS AND ROADWAYS.

The highways and roads throughout this consular district can be classified as natural roads, and seldom laid out with engineering skill. The bridlepath or trails made and used when the country was first populated (or old Indian trails) from one small settlement to another became (in the course of time as the population increased and wagons were introduced, the trees and undergrowth of bushes were cut away to widen the bridlepaths and trails) roads over which the cumbrous ox carts and wagons which were first used could pass. The persons who made most use of the roads, with their wagon trains, made the necessary repairs to keep them transitable. As land was of little value, and most of it (at one time) public land, there was no difficulty or question as to the "right of way." The land not being fenced or inclosed, excepting to small extent near the settlements once established, these bridlepaths and roads became highways for public trade. To-day in Sonora these roads between the villages, towns, and cities are kept in repair principally by the owners of freight teams and stages. The country not being fenced, if a portion of the road from excessive rains or other causes becomes impassable, a road is made around the bad places by cutting away the brush and trees and leveling the ground so that wagons can pass. When streams of water are met (there are no

large rivers in Sonora) they are forded at the shallow places. In among the valley lands (which are the only lands cultivated) if the land-owner wishes to utilize what has been used as a highway he must provide a roadway for the public around the edge or border of the land, or fence on either side of the road (before used). In some parts of Sonora work has been done on roads by the authorities of the district calling on the owners of the land to assist in grading or straightening the same. In other parts a road tax is levied on the landed proprietor and is paid, either in money or work, for a few repairs indispensably necessary. There are no macadamized roads or toll roads, or bridges over which tolls are charged, in Sonora. There are bridges, but there are none over one span, and these principally over irrigating ditches, the said bridges erected by the owners of the ditches.

As this consular district is but sparsely populated, and the roads over which the freight wagons and stages travel not being in mountainous districts, no especial road laws are carried out systematically by the State government.

A. WILLARD,
Consul.

UNITED STATES CONSULATE,
Guaymas, December 1, 1890.

TAMPICO.

REPORT BY CONSUL LIEBERKNEOHT.

There is not a street in this city fit for a carriage to drive over. The streets are all paved with small cobblestones and set not over 6 inches in the ground, without any kind of a foundation.

There are no country roads whatever in this section of country, nor wagons or carriages. Everything is carried on horse or mule back, and by water in canals.

Trails take the place of roads here.

A. LIEBERKNECHT,
Consul.

UNITED STATES CONSULATE,
Tampico, March 16, 1891.

TUXPAN.

The streets of this port are such crude affairs, being rocks of all shapes and sizes simply laid in earth, having no uniformity as to level, and being left entirely to the property owner who is obligated to clean and repair not only the sidewalks but to the center of the street, public roadways are not more than paths which, owing to the entire

traffic being done by pack mules and Indian porters, are only kept open by the people living on same who are required by law to work 3 days every year cleaning out weeds and overhanging boughs.

These roads are never graded, and no vehicle could or ever has passed over them; in fact, during the rainy season they are almost impassable by man or beast.

JOHN DRAYTON,
Consul.

UNITED STATES CONSULATE,
TUXPAN, *December* 6, 1890.

CENTRAL AMERICA.

NICARAGUA.

REPORT BY CONSUL NEWELL, OF MANAGUA.

CITY STREETS.

After thorough inquiry and careful investigation I have to report that the streets and roadways of Nicaragua are of the most primitive character.

The streets show that very little labor has been expended upon them. The nature of the earth forming the streets is such—volcanic formation—that it makes a good hard street without the necessity of artificial means being used to improve it. So hard and firm is this earth that, notwithstanding the long rainy season of the country, it does not form into mud; the water flows over it as if it were asphalt or macadamized.

The streets of nearly all the cities of Nicaragua are laid out and made in the same way. They all have the peculiarity of running for a short distance on a perfect level, then rapidly rising by a steep incline to a second level, and so on. This steep incline is paved with cobble stones or broken pieces of rock, so as to enable teams and horsemen to ascend or descend without danger.

In the city of Leon an attempt, in a small way, has been made to pave some of the streets. Cobble stones, and square blocks of stones, somewhat similar to Belgian blocks, have been used, but the distance paved would not exceed the length, on any one street, of 500 feet.

So little expense attends the building or maintenance of the streets of Nicaragua that it is almost reduced to a cipher.

COUNTRY ROADS.

The country roads are made by cutting down the trees and the small undergrowth, and removing from the way of the proposed road the large rocks. Outside of this manner there is no other adopted in this coun-

try. The cost of building roadways in Nicaragua it is impossible to arrive at, as there is no data kept of these matters.

WILLIAM NEWELL,
Consul.

UNITED STATES CONSULATE,
Managua, March 5, 1891.

SOUTH AMERICA.

BRAZIL.

BAHIA.

REPORT BY CONSUL BURKE.

COUNTRY ROADS.

There are no country roads, and but very little can be said of "city streets."

Communication between towns where there are no railways to the interior is by water in small boats or canoes, or by bridle paths on donkeys, mules, or horseback. To go in a carriage of any description 5, 10, 20, 40, or any number of miles, few or many, into the interior, is a thing unheard of and unknown; and this for two very good reasons, viz: First, there are no roads for a carriage, and in the second place there are no carriages, excepting those owned by livery-stable proprietors, and these are rarely used except for funerals, weddings, and baptisms.

In this city of 200,000 inhabitants, perhaps, there are not over five families that have their own turnout. All the merchandise sent from this city to the interior of the State must be taken to some seaport in small craft and then sent by rail, by river, by donkey, mule, or horse to its destination. Very little is sent by rail, as the number of miles of railway in this State and Sergipe is very limited, so that nearly all the merchandise imported, as well as the exported, products must be taken by water up or down the river, and by donkey or mule, simply because there are no roads.

From the city of Bahia to the southwestern part of the State it requires at least 30 days to make the journey. The journey by rail is 450 kilometres,* thence by horse or muleback to the San Francisco River, up the river in a small boat, then again by mule, donkey, or horseback till the town in the interior is reached.

Some idea of the difficulties and vexatious delays in traveling in this country may be obtained when it is known that to cover a distance some

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* 1 kilometre = 0.62135 of a mile.

200 miles less than from New York to Chicago (24 hours), it takes 30 days in this district—days of discomfort not only in the actual traveling, but also in the eating, drinking, and sleeping. The people are very hospitable, so it is not from this cause the discomfort in traveling arises. It is simply because actual comfort in going from town to town, such as one finds in the States, has never existed here; consequently neither the country nor the people can give what it has not. When one leaves the rail or the boat he simply mounts his horse, mule, or donkey, having provided a guide if not familiar with the country, and follows the trail, for it is nothing more, till he reaches his destination.

Women who find it necessary to travel must adapt themselves to the same conditions as the men.

CITY STREETS.

Of the streets of the city of Bahia, I can say that in general the pavement is very bad and very rough.

The principal street in the lower and in the upper town is the best paved in the city. Nearly all the other streets, with a very, very few exceptions, are wretchedly paved and very badly kept.

About 20 years ago the principal street in the lower and upper city was paved with stone, brought from Rio de Janeiro. It is, I should say, the ordinary paving stone consisting of blocks from 8 to 12 inches in length, from 3 to 6 wide, and from 4 to 6 deep. There was no attempt at system in paving the other city streets evidently, as all sorts and all sizes of stone are seen. One street called Ladeira da Barra was macadamized recently, and a sidewalk of the same kind made and covered with Portland cement, to give it a smooth surface. There is very little teaming done in the city. Nearly all the merchandise in the lower city, is moved on the heads of negroes, or on a four-wheeled vehicle, small wheels, all of the same size. These wagons, if such they may be called, are chiefly employed in removing merchandise from the custom-house to the different stores or import houses. This wagon is drawn by negroes. There is also in use a two-wheeled cart, called a carroca, drawn by a mule, upon which may be placed 4 or 5 barrels of flour or its equivalent in weight of some other article or product. This little four-wheeled wagon and the carroca constitute the entire wagon traffic of the city, so that a street well paved will last here for years without repair. Whenever heretofore any street required paving the work was done under contract from the municipal government. Repairs whenever made were under police authority, but now a company has been formed under the name of "Companhia de Calceteiros," or paving company. This company has received from the municipal government instructions as to what shall be done in the line of paving the streets, where it shall be done, what new streets shall be laid out, which ones shall be repaired, prices paid for work, etc.

The wages established by the day, a day of 10 hours, are as follows:

	Milreis.*
Superintendent	3
Assistant	2½
Foreman	2
First-class pavers	2
Second-class pavers	1⅔
Third-class pavers	1⅗
Attendants	1⅓

Payment to employés must be made weekly. If any work should be done under contract by this company the prices fixed are from 400 reis (21.8 cents) to 1,800 reis (98.3 cents) per square metre, depending upon the size of the stone laid. If flagstones are laid for walks the price is 16 milreis per cubic meter. If the walk is of brick, the price is 22 milreis per cubic metre. The price of the material depends on whether it is imporor or not, it also depends upon where material is obtained; the difficulty and expense in getting it, the quality of the stone employed in construction, and other things that have a tendency to raise or reduce the price.

Rent is naturally higher on the best streets of the city, where, as a rule, the houses are in a much better condition than in the poorer city streets.

DAVID N. BURKE,
Consul.

UNITED STATES CONSULATE,
Bahia, January 20, 1891.

PORTO ALEGRO.†

The street superintendent to the president of the municipal council, translated and transmitted by Consul Negley, of Rio Grande do Sul.

In obedience to the official order of the 29th of January last, No. 22, by which I am directed to answer the questions asked by the citizen consul of the United States of North America, I answer as to the first question, What material is used in the construction of the streets? In order to give a satisfactory answer to this question it should be borne in mind that the city is built upon an eminence, which is divided into three sections, a high section in the center, a low section to the north, and a low section to the south. In the high section the material employed is a mixture of two-thirds sand and one-third clay for the construction of the bed, because the ground is gravelly and in part rocky, and on this bed are placed granite stones of irregular sizes, from 15 to 20 centimetres in width and from 10 to 15 centimetres in depth, placed well together one against the other and covered with a light layer of sand, in order to fill up the small crevices occurring in the laying of the stones. As to the low part of the city in the north, where the ground is composed of a filling of soil, the work is the same, with the difference that in place of one-third clay for the construc-

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*1 milreis = 54.5 cents.

†Porto Alegro, a city of 50,000 inhabitants, situated in the northern part of the State of Rio Grande do Sul.

tion of the bed, it is entirely of sand. In the southern section, where the ground is sandy, the stones are merely laid down in the same way as if the bed had been artificially prepared, except that in the clayey places the same method of laying the stones is followed as in the higher sections.

As to the second question, What does the material cost? Stone, Rs. 4$000 ($1.60, exchange at 40 cents to the milreis) per cubic metre; clay Rs. .640 (25 cents) per cubic metre; manual labor 1$100 (44 cents) per square metre; amounting to Rs. 1$600 (64 cents) per square metre for material and labor.

As to the third question, In what manner are the streets made? This is answered by the response to the first question, adding, however, that the new streets are made 17.60 metres in width.

As to the fourth question, Is there any difference between streets for light traffic and for heavy traffic? None, absolutely. There is, however, the inconvenience that the streets for heavy traffic are soon worn out, when they are immediately reconstructed *de novo*, always by the same system.

As to the fifth question, What is the depth and on what foundation are the streets made? In the high part of the city where the ground is gravelly or rocky, 30 centimetres, and in the low section on the north side, 50 centimetres depth of sand, and in the low section on the south side from 15 to 20 centimetres in depth.

As to the sixth question, it is answered in the second.

As to the seventh question, What is the cost of repairing the streets? Never less than 1 milreis (40 cents) per square metre, by contract.

As to the eighth question, Is any assessment imposed upon the adjoining property to make or to repair the streets? None for the municipal coffers, but the State treasury collects a tax of 10 per cent. on the assessed value of the property, not returning anything to the municipal coffers.

Here is the information that I have been directed to give to you.

Health and fraternity,

THE GENERAL SUPERINTENDENT.

PORTO ALEGRO, *February* 13, 1891.

RIO GRANDE DO SUL.

REPORT BY CONSUL NEGLEY.

In response to the "street and roadway" circular lately received from the Department. I beg to transmit herewith a report by the city engineer of Pelotas in answer to some questions submitted by me to him on this subject. His answers will cover the ground for the cities of Rio Grande do Sul and Porto Alegre as well as for Pelotas, as the streets in these, the three principal cities of this State, are all made in substantially the same way and at no great difference in cost. The streets of Pelotas are perhaps the best of the three, and are indeed better than in a majority of the cities of the same size in the United States. I speak of the paved streets. As for highways there is so little attempt at improvement it is not worth while to mention them.

CHARLES NEGLEY,
Consul.

UNITED STATES CONSULATE,
Rio Grande do Sul, February 4, 1891.

THE STREETS OF PELOTAS.

[Inclosure in Consul Negley's report.—Translation.]

DEPARTMENT OF THE PUBLIC WORKS OF THE CITY OF PELOTAS,
January 24, 1891.

In response to the questions formulated in the request of citizen consul of the United States resident in the city of Rio Grande, I have the honor of presenting the following points:

(1) What material is used in the construction of your streets?—Answer. As to the first question I answer granite, vegetable earth, and sand.

(2) What does the material cost?—Answer. As the second question, 15 kilos of stone cost 65 reis (.02½ cent), 15 kilos of sand cost 20 reis (.008 cent) and 15 kilos of vegetable earth cost 15 reis (.006 cent), (Exchange at 40 cents to the milreis).

(3) In what manner are the streets constructed?—Answer. As to the third question, by filling in earth or by paving.

(4) Is there any difference between streets paved for light traffic and for heavy traffic? If so, what?—Answer. As to the fourth question there is no difference; they are always made so as to give the resistance necessary for the pressure exerted by vehicles for the transportation of freight.

(5) What is the depth and on what foundation are the streets made?—Answer. As to the fifth, the foundation is of plastic clay, impermeable, merely covered by one light layer of vegetable earth, which varies from 20 centimetres to 50 centimetres at the greatest. As to the method of proceeding: If it is only for filling in earth, there is a mixture made of sand, vegetable earth, rubbish, and clay and given a convex form, placing on the sides stone gutters or drains for carrying off the waters; if for paving an excavation is made of 50 or 60 centimetres, if such should be necessary, and filled with vegetable earth well packed to 30 centimetres, and on the top of that a layer of sand as a foundation for the stones; when the foundation is of clay, on the other hand, there is placed sand and stone, rough hewn, of the following dimensions, 0.08 centimetre on the upper face and 0.12 centimetre in depth at the middle when the stones are irregular.

(6) What does it cost to make the streets, per square metre in the first place?—Answer. As to the sixth this is very variable, because in some streets there is a necessity to fill up more or less, and in others to excavate more or less. It has been the rule to pay for a cubic metre of filling or excavation 450 reis (18 cents) and as much more for transportation. As for the cost of pavement the price at present for a square metre is 1.750 milreis (70 cents), ready for use.

(7) What does it cost to keep the streets in repair?—Answer. As to the seventh, the cost of repairing the paved streets amounts on the average to 3,500 milreis ($1,400).

(8) Is there any assessment imposed upon the adjoining property either to make or repair the streets?—Answer. As to the eighth, yes. The owner of adjoining property is obliged to furnish the stone necessary for the pavement in front of his property as far as the middle of the street; so also he is obliged to make or cause to be made at his own expense the sidewalk along the boundary of his property of the height and width designated by the city council, and if it should happen that he refuses or neglects to furnish the stone necessary he will be punished by a fine of 1.600 milreis (64 cents) for each square metre of pavement in front of his property, which amount will be applied to the benefit of said pavement.

Health and fraternity,

ROMUALDO DE ABREU E SILVA.
Engineer.

COLOMBIA.

BARRANQUILLA.

There are no roadways in this consular district. Aside from river and railway transportation every thing is carried upon the backs of mules.

The streets of the cities are entirely unimproved. From this view of the subject in this consular district there is nothing upon which a report can be based as requested in said circular.

JOHNSON NICKEUS,
Consul.

UNITED STATES CONSULATE,
Barranquilla, February 23, 1891.

DUTCH GUIANA.

REPORT OF CONSUL WYNDHAM.

The roads in this town are not made, but are the existing shell reef, on either side of which the streets are constructed by houses being built, and these roadways are only repaired by occasionally dumping extra shells where the road is worn away too much.

The buildings on the roadside are not allowed to encroach on the roads, which have to be kept open a certain fixed breadth.

In the districts no roads exist, communication being only by boat on the rivers that intersect the colony and by creeks joining the rivers.

I fear it would be impossible to give any points on road-making from this very primitive colony that would interest the mayor of Boston.

WM. WYNDHAM,
Consul.

UNITED STATES CONSULATE,
Paramaribo, December 22, 1890.

VENEZUELA.

REPORTS BY CONSUL BIRD, OF LA GUAYRA.

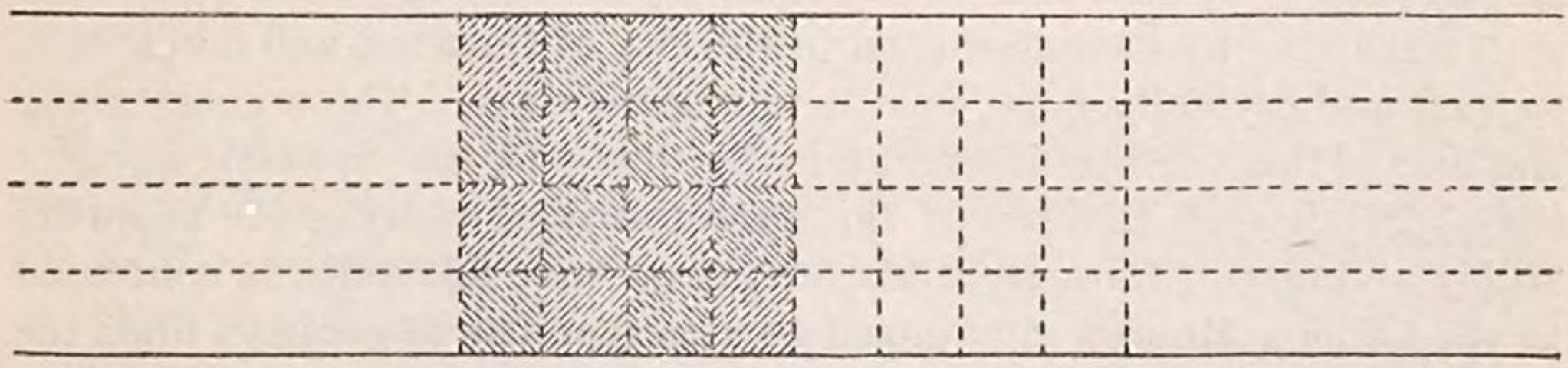
CITY STREETS.

It is assumed from some personal knowledge and from general information that the streets of La Guayra and of Caracas, the capital of Venezuela, are the best in the Republic. Most of these, except in the center of the latter city, are very narrow, so much so that they barely afford passage way for two coaches abreast. They are thus built in order to avoid, in some measure, the tropical heat and glare of the

midday sun, and the overhanging balconies of the upper stories of the houses also contribute to the same effect. Besides, it appears that the currents of fresh air forced through these narrow streets and alleys are much stronger than the feeble breezes that stir through the wider thoroughfares.

In the matter of street paving the Venezuelans have adopted and still maintain the methods of their ancestors, the Spaniards, who settled the country over 300 years ago, and it may be added that these methods have undergone no change, as is observed from much of the old Spanish work still in existence on deserted roads and streets. It is true that some asphalt block pavement has been recently put down in front of the executive mansion in Caracas that presents a pleasing contrast to the old style of pavement, but the improvement seems to have been confined to that particular locality, and there is no prospect of its further extension, and it should be stated that the exorbitant freight rates of the railway from La Guayra to Caracas, precludes the idea of importing paving material. Nothing especially suitable for the purpose is found in the environs of Caracas, and, therefore, such poor material as can be obtained must be made use of. There is an abundance of good brick clay near by, but no facilities for vitrifying the brick, as is practiced in the United States, and hence this material is unavailable.

The street, after being carefully graded, is laid out in long parallel lines, 3 feet apart, into which cobblestones set on edge are planted. Cross lines of stone are then set up at intervals of 3 feet, so that the entire street is laid out in 3-feet squares. These squares are then filled up with diagonal lines of cobblestone set on edge, and, when carefully executed, the paving presents a rather pleasing effect. The plan thus explained is illustrated as follows:



After this paving is completed the entire work is covered with a heavy coating of sharp sand that fills the interstices of the stones and makes the pavement more solid.

Owing, it is presumed to faulty preparation of the subsoil, to the poor quality of stone used and to the careless manner in which it is set up, this pavement can not resist the rolling and pounding of heavy traffic, and, therefore, the business streets of the city are being constantly repaired.

COUNTRY ROADS OR HIGHWAYS.

The northern limit of Venezuela, traversed from east to west by the Cordilleras and Parima mountain ranges, is very rugged and broken for a distance of 70 miles south of the Caribbean seacoast, and hence the construction of highways over stupendous precipices, through almost impassable gorges, and around lofty mountain summits is a work that requires engineering skill and considerable outlay of capital. These prerequisites have never been contributed by the Government of Venezuela; for, if we may except the short coach road from La Guayra to Caracas and the few roads from Caracas to the outlying towns and villages near by, there are no roads in this part of the country that can be properly designated as such. Even the best of them are mere dirt roads kept up in a primitive way; and if, as in the United States, a prolonged rainy season should occur, they would soon become impassable. The road from La Guayra to Caracas above alluded to, although well laid out over great natural obstructions, is very badly kept, and transit over it becomes, at times, difficult and dangerous. The roads, so called, south of Caracas, leading into the interior of the country, are, generally speaking, miserable bridle paths, over which long trains of donkeys transport produce to and merchandise from the city of Caracas. Indeed it may be confidently stated that there is not a 5-mile stretch of third-grade roadway in this consular district.

The old Spanish road from La Guayra to Caracas, about 12 miles in length, now long abandoned, is a curious and interesting relic of the old colonial times, and suggests the idea that perhaps the aborigines of this country had in the Spaniards quite as severe taskmasters as those that weighed the straw and taled the brick for the patient and oppressed Hebrew. All of this wide highway, except some short stretches of level land on the mountain top and along its side, has been well paved in the style now used in the city of Caracas, and much of it, so well and carefully done, is still in a good state. The scenery along the line of this old way is exceptionally fine, and the Spanish cavalier upon arriving at the top of the mountain, and viewing the beautiful valley and city of Caracas at his feet, must have felt quite as contented as the famous Hebrew that gazed westward across the Jordan upon the country reserved for his people.

From the foregoing statement it must appear that none but the most primitive methods are employed in making and maintaining public roads. All the details of the work are of the simplest kind, and the execution by common laborers poorly paid is very inexpensive. The opening and improving of public roads and highways is under the direction of the General Government, but new roads are rarely or never thought of, and others are only improved when they become impassable. Such a system, it may well be imagined, contributes little or nothing to the value of lands contiguous to these roads and constitutes a serious

barrier to profitable commerce between Caracas and the interior country.

WINFIELD S. BIRD,
Consul.

UNITED STATES CONSULATE,
La Guayra, December 10, 1890.

BRITISH WEST INDIES.

ANTIGUA.

REPORT BY CONSUL BRADFORD.

There are at present, in Antigua, about 10 miles of streets and 140 of roadways, kept in thorough repair at an annual cost of about $15,000, besides which there is an annual grant of $1,200 for mason work and repairs to bridges. Construction and maintenance are both carried on under the provisions of the road act of 1880,* which is very comprehensive, and has, I am given to understand, worked to the satisfaction of both the citizens and the government.

Under the act the highways are divided into five classes: Class I embraces the 10 miles of streets; Classes II, III, IV, and V are all country and suburban roads. The division was made (1) with reference to greater or less difficulty, in places, or obtaining suitable stone; (2) to the amount of traffic likely to pass over a road; and (3) to the greater or less liablity to drainage by heavy rains. It has been found to simplify very much the system of construction and repair, and has worked well during the past 10 years.

Convict labor is permitted, within a radius of 1 mile from St. John's, on six of the most frequented roads and on that leading to the naval station at English Harbor.

CITY STREETS.

Construction.—The streets of St. John's are constructed and kept in repair by the superintendent of public works and the cost defrayed out of the ordinary taxes, as in our own cities. The method of construction is as follows:

The surface earth is carefully excavated to a depth of at least 12 inches and leveled. This street bed is then covered with 4 inches of "grit"† or similar durable material, and with this layer the contour of the road way is formed, as to the height of the crown of the street and its slope and level. In this material no stone over 1½ inches in diameter is permitted. Over the grit an even stratum of broken stone is laid to a depth of 8 inches. This is called "metaling." The whole is then covered with grit and sand, as a binding material, spread

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* Legislative council, Leward Isles, No. 7, July, 1880.

† Stone broken or mashed very fine.

to a depth of three-quarters of an inch. A curb, composed of stone blocks 10 by 14 inches in diameter and 8 inches thick, strongly cemented together, separates this roadway from the sidewalk, and at its base a wide gutter is formed. The curb is composed of the stone found on the island—usually crystalline limestone—and the gutter is either of the same stone, of brick, or of large square tiles.

The sidewalks of the city streets were intended to be of a width of 8 feet, but the citizens have in so many instances encroached upon them by verandas, flights of steps, etc., that it may be said there are no sidewalks in St. John's. Some buildings project so far as to leave barely 2 feet width between the curb and the front of the houses. It is understood, however, that this will be corrected. What sidewalks there are are not paved, except in a few instances under the porticos of prominent business houses where stone flags are laid. Drain pipes, 12 inches in diameter, and culverts are laid throughout the city, so that the streets are rarely flooded, even in the heaviest rains.

The height of the crown of the causeway varies according to the profile of the surface, in some streets being about 6 inches above the gutter level and in others a foot, or even more.

When the construction of a street has been thus completed it requires at first little attention beyond the smoothing down of wheel tracks and the filling up, with broken stone, of ruts or hollows caused by vehicles constantly following each other in one track. This filling up is continued until the roadway has become thoroughly consolidated, and it must be remembered that this desirable consummation can be obtained only through the travel over the street and this constant supervision, for there are no steam-rollers and no hand-rollers of sufficient size in the islands; but once the roadway is finally completed its endurance is very great. It will need absolutely no repairs for a very long time and then but slight ones.

Such streets as I have just described can be constructed here for only 9 cents a square yard, and kept in repair with the insignificant outlay of from $100 to $150 a linear mile. They are solid and firm—never dusty in dry weather or muddy in wet—and are, except where out of repair, so easy to the pedestrian that the reason for the neglect of the sidewalks is at once apparent.

Repairs.—The maintenance of the street-ways in St. John's is part of the duty of the superintendent of public works, who likewise designs, constructs, and repairs all bridges, culverts, etc. Repairs are made by day labor, and consist of filling up holes, ruts, or other defective places in the "macadam." This is done by first breaking up the surface to a sufficient depth over and for some distance around the site of the defect, then removing this old surface and spreading over the place thus uncovered a layer of broken stone, averaging about 2 inches in diameter. This, again, is covered with coarse sand and grit as a binding layer, and the street is thrown open to traffic. Where repairs are

required throughout the whole width of a street the metaling with hard stone is done only in the middle—say to a distance of about 6 feet on each side of the crown—while at the sides and up to the edge of the gutter only light material, broken up fine, is used, and for this purpose the common "mud stone" of the island is most in vogue, covered with a thick layer of sand and grit. The reason of this is obvious, the traffic in the middle of the street being ten times as great as that at the sides, which last is almost altogether pedestrian.

Where narrow streets or alleys are to be repaired it is usual to matel them from gutter to gutter.

The street in front of this consulate has just been repaired in this manner, and, although completed only a week ago, is now in excellent condition for travel of all sorts.

The cost of these repairs is about from $100 to $150 per mile annually. Taking it at the larger cost, it amounts to a little less than 3 cents per square yard.

COUNTRY ROADS OR HIGHWAYS.

As mentioned in the introduction to this report, these roads are also macadamized, with a few exceptions. The stones used in metaling are such as are found in the vicinity of the road being constructed, and are chiefly hard crystalline limestone, flint, and obsidian, to which may be added, for volcanic districts, trap rock. The stone for the roadbed is broken up very fine and mixed with grit. Flint, obsidian, or limestone is broken to a size that will pass through a 2-inch ring, but volcanic rock is crushed still smaller, say about an inch and a quarter.

Construction.—In construction the first thing after the location and leveling of the proposed road by the surveyor is to pare off all of the surface mold. Then the roadbed must be made of mashed stone and grit (or like enduring material), taking especial care to see that no stone larger than 2 inches in diameter is found in this layer. The shape of the road from crown to side trench (ditch) is formed with this layer of grit and stone. Natural hollows, where not too large, are also filled up with it to the required level of the road. After this is completed the road is "metaled" to an uniform depth of at least 6 inches, and this final stratum of stone is covered half an inch or more with grit and, occasionally, sand and gravel as a binder. Side trenches or ditches are dug, and, in particular cases, where heavy washings from the winter rains may be anticipated, these ditches are faced with masonry. The cost of the mason work is, however, as before mentioned, defrayed from the special fund of $1,200 per annum allowed for masonry and bridge repairs. The building of the walls, culverts, bridges, etc., is done by the government and is not charged to the road fund.

Thus built, these roads cost, exclusive of bridges, etc., $1,260 to $1,270 per linear mile.

The stone for the foundation and metaling can be carted from a

reasonable distance, say from one-half to three-fourths of a mile, broken up and spread upon the road at a cost of from 8 cents to 12 cents a barrel for limestone, and for from 12 to 16 cents for flints and harder kinds of rock. These latter, especially volcanic stones, require to be broken to a smaller size than the limestone, say 1½ inches in diameter at most. The barrel used in measuring the broken stone is an ordinary flour barrel, without top or bottom, and contains about 4 bushels of stones or 5 cubic feet.

It is proposed now to use in future construction or repairs the petrified mud, which is here called "mud stone," as a binding material for roads where there is much traffic, and this proposition is meeting with much favor, especially in localities where flints are used in metaling, and will, in all probability, be adopted. The advantages of the mud stone are that it forms with the hard stones a more even surface, being not easily ground or pushed out from between the flints, and that it takes less watching when newly laid, soon settling down with the hard stones of the road into a smooth, compact, and consolidated mass.

Repairs.—These are made by the government, except where the roads pass through an estate or between two estates. In the latter cases, by the road act of 1880, the repairs must be made by the proprietor or occupant of the estate (see sec. 5 of the act) or abutting estates, and for such repairs the government, on proper representation, remunerates the proprietor or occupant according to the schedule of rates given below.

Should any proprietor or occupant neglect to repair the road where it passes through his estate he is first notified officially and in writing of such neglect, and should he, after the formal service of such notice, allow 10 legal days to pass without commencing such repairs, they shall at once be effected by the superintendent of public works, and the cost, together with a fine of 40 shillings or $9.73, shall be charged to the estate. This cost and fine are recoverable before a discrict magistrate like any other simple debt. Where the road is greatly damaged, as by freshets or heavy rains, the proprietor is allowed 21 days to complete the repairs, but he must, in the mean time, make it passable for vehicles.

Schedule of rates at which payments are made for repairs on country roads.

Class.	Repairs.	
	Allotment per mile.	Annual amount.
*I.	First 4 years	$121.00
	After 4 years	170.31
II.	First 6 years	77.86
	After 6 years	97.33
III.	First 8 years	58.40
	After 8 years	67.07
IV.	No longevity allowance	29.20

* This is Class II of the general classification of the streets and roads of the island; and so with the other three. Class I, in the general arrangement or division, is formed by city streets.

There was formerly an extra allowance for metaling, but that repair is now done by the superintendent of public works. It must be remarked, in this connection, that the roads under repair are rarely if ever metaled to any considerable length unless there is great damage by floods. As a rule all the repairs required besides trenching are the filling up of ruts and hollows as they appear. If proper attention is paid to this the roads will rarely require extensive metaling. In repairing precisely the same method of procedure is followed as in the repairs of streets (see pp. 4–5), with the single exception that there is not so much excavation, nor is it at all necessary. Ruts or holes are simply filled up with broken stone of from $1\frac{1}{2}$ to 2 inches in diameter, and a binder spread over all. In cases of severe washing it is usual to take counsel as to the proper repairs with the superintendent of public works.

GENERAL REMARKS ON ROADWAYS.—It is to be remembered in considering the depth of excavation and the material used in these macadamized roads that the traffic over them is what would be generally recognized as light, the heaviest weights which ordinarily pass over them being "estate carts," drawn by two or four mules and loaded each with 1 or 2 hogsheads of sugar weighing a ton apiece. Yet heavy boilers weighing from 8 to 10 tons and steam plows are occasionally carted over them without doing any damage, especially if the roads are dry and unwashed.

In considering also (2) the question of the low rate of cost in making and maintaining these roads as compared with the cost of properly macadamized roads in the United States it must be remembered that the wages of the laborers in the Leeward Islands averages from 20 to 28 cents a day, as opposed to $1.50 with us. As an offset to this, however, the laborers in the West Indies do but a small day's work as compared with that accomplished by a laborer in our own streets and high ways, a fact which renders the contrast less striking. It may be safely estimated that a day's labor in these islands is equal to about half a day's labor in the temperate zone, so that taking into the account the difference in cost of living, the actual wages of labor in making and maintaining the road in the tropics would be about one-third of what it should be in the United States or Canada.

GENERAL EFFECT OF IMPROVED HIGHWAYS.

That easy and quick transportation of land products from the place of production to the port of shipment reduces the cost of said products delivered at the port goes without saying. What the actual amount of saving in money values is I do not know and have no means of learning. The planters keep no record of such saving. The simple fact, however, that whereas sugar in former years (previous to the adoption of the act of 1880), was worth, delivered for shipment, $45 a hogshead and is now delivered at $40 speaks for itself. Nor can the whole of

this reduction, nor even a large part of it, be traced to the abolition of the export duty, which was only 97 cents a hogshead. That duty was only abolished in 1888; and, besides, the sugar planters assert that they never received any benefit whatever from the abolition of the duty, the amount of the reduction having been absorbed by the "middlemen." And it does not require a profound mathmetician to determine the result in reduction of price arising from quick and easy transportation to market as compared with the loss of time and labor and the injury to the stock and vehicles by bad, miry, and broken roads.

In conclusion I would say that, notwithstanding their small relative cost, I have never seen better roads than those in this island, and seldom as good. They are smooth and even; and although I write in the middle of the rainy season, I have never seen enough mud on them to impede in the slightest degree traffic either light or heavy. The lightest and most delicately made sulkies and road wagons travel over them daily without the slightest injury; and (which is of greater importance to the commerce of the island) the time occupied in transportation of sugar and molasses during the rainy season to the port of shipment is diminished by at least one-half.

JOHN S. BRADFORD,
Consul.

UNITED STATES CONSULATE,
Antigua, January 14, 1891.

RECAPITULATION.

Miles of streets (approximate)	10
Miles of roads	140
Annual cost of construction of streets:	
Per linear mile	$1,537.880
Per square yard	$0.093
Annual cost of repairs of streets:	
Per linear mile (average)	$150.000
Per square yard (average)	$0.026
Annual cost of construction of roads:	
Per linear mile	$1,267.200
Per square yard	$0.080
Annual cost of repairs of roads, variable according to class:	
Per linear mile	$29.20 to $121.000
Per square yard	$0.005 to $0.020
Wages of laborers per diem	$0.20 to $0.280
Cost of material per cubic foot	$0.02 to $0.03½

System of construction and repair, Macadam.

REPORT OF THE COMMISSION ON PUBLIC ROADS, ANTIGUA.

To his excellency Sir WILLIAM FREDERICK HAYNES-SMITH, K. C. M. G., Etc.:

(1) The commission appointed by your excellency to inquire into the whole question of the maintenance of the public roads in Antigua held its first meeting on the 20th January last.

(2) With the object of gathering the views and wishes of as many as possible of those specially interested in the question before the commission, the island was divided into districts, and the leading planters, or their representatives, in each district were invited to attend before the commission.

(3) Of the thirty so invited eleven were good enough to attend and to give the commission the advantage of their coöperation and assistance.

(4) The information elicited from these gentlemen will be found in detail in the minutes of the proceedings appended hereto.

(5) The labor of the commission was much facilitated by the unanimity of opinion which prevailed among the witnesses with regard to the main principles of the present road act, which was thought to have worked admirably, and to require but little if any amendment.

(6) The system of paying the estates to keep the roads in repair was unanimously approved, and it was the general opinion that no alteration in the rates of remuneration was necessary, inasmuch as although the amount paid for repairs to one portion of a road might not cover the cost of such repair, that paid for repairs to another portion would be in excess of the cost, and that an average was thus arrived at which enabled the estates, as a rule, to keep the roads in repair without either loss or profit.

(7) A proposal for repairing all roads under a system of contracts met with no support, although it was thought that where the surveyor of works has roads to repair tenders might with advantage be called for in the majority of cases, and in this latter suggestion the commission concurs.

(8) There was a diversity of opinion as to the amount of supervision that ought to be given to the roads, and it was suggested that the island should be divided into two or more districts with an overseer for each, but after carefully weighing the whole of the evidence the commission is of opinion that the supervision now provided should be sufficient; that on the whole it has proved so, and that no immediate necessity exists for any increase of staff.

(9) The drains and gutters running across the roads were objected to as they are now made, and it was the general opinion that strong culverts should be made where possible, and where not possible simple and inexpensive bridges should be erected.

(10) The use of 12-inch pipes was suggested and the commission consider that much might be done to make the roads more level and easy to drive over if such pipes were used, and if the estates were required by law to keep the culverts and pipes free from obstruction and choking.

(11) It was also suggested that where estates required to make drains across roads pipes for this purpose should be supplied at cost price by the government, and to this the commission can see no objection.

(12) Paying the estates for keeping in repair the cross-gutters, culverts, bridges, etc., adjoining their property on the same plan as payment is made for repairs to the roads was suggested, and although the commission considers that the surveyor of works should, subject to the approval of the governor in each case, be authorized to make arrangements for doing this where practicable, it is unable to recommend the suggestion for general adoption in the sense in which it was put forward in consequence of the difficulty there would be experienced in arriving at a proper settlement of the amounts payable.

(13) The making of mould traps too near the public roads was pointed out as not only the case of much avoidable expense in keeping the side drains open, but as a source of danger to persons riding or driving, and the commission suggests that the making of mould traps anywhere within 10 feet of the trench running along the public road should be forbidden and made a punishable offense.

(14) With regard to the material to be used upon the roads for their repair, it was pointed out that although provision is made in the road act (No. 7 of 1880) for the use of metal no provision is made for the use of other material, and although the com-

mission considers the provision for metaling very necessary and one which should remain in force, it is of opinion that where the use of metal is not necessary the surveyor of works should have power to order the use of some other suitable material.

(15) The word "metal" has not been defined in the act, but has been taken to signify "broken stone."

(16) The stones put upon the roads were considered to be, in many cases, too big, and the use of flint was taken exception to. As to the size of the stones this is a matter which should, the commission thinks, be regulatid by the surveyor of works, and with regard to flint the commission can see no objection to its use provided that when used it is covered with some suitable binding material. The commission would suggest that a provision to this effect be made.

(17) In many of the roads and side drains a rocky surface presents itself, and the commission suggests that where practicable and desirable this surface should be blasted or otherwise disposed of, and that when the roads so treated are repairable by estates they should be put in order before being handed over again to the estate.

(18) A suggestion made by one of the members of the commission (Mr. Oliver Nugent) that a system of tramways should be arranged along the main roads of the island appeared to meet with universal approbation, and the commission would suggest that a few gentlemen of the island be selected to consider and report upon the practicability and cost of carrying out such a scheme.

(19) The proposed abolition of fourth-class roads was not generally approved, and the commission is of opinion that as these roads are better than no roads they certainly should be retained on the schedule.

Their removal generally to the third-class could not be entertained on the score of expense.

(20) There was no general complaint as to the manner in which the roads had been measured, and it was not ascertained that any required remeasurement.

(21) Some of the roads, it was thought, should be widened to the width required by the act, and the commission considers this should be gradually effected along the most frequented routes.

(22) It was suggested that estates in receipt of grants for the maintenance of roads should be compelled to keep and render accounts of their expenditure; the commissioners, however, do not see that these accounts could be properly audited, or that in the absence of an audit any material advantage would be derived from an adoption of the suggestion.

(23) The posts, defining the boundaries of the various estates, are looked upon as of distinct advantage, and their upkeep and renewal where and when necessary is recommended.

(24) The commission did not consider it came within its province to entertain applications for the removal of roads from one schedule to another, bnt rather that such applications should follow the usual course and be dealt with, each upon its own merits, as heretofore. The condition of the road from Elm's stream through Gray's and Wickham's was however brought prominently to notice, and the commission recommends that, so far as this road runs through the swamp, it should be remade and raised some feet above its present level by the Government, the estate being required to keep it in repair thereafter.

The road from Fry's to Bodkins should be a first-class road throughout; at present part is second class and part first. The commission makes this recommendation in consequence of the extraordinary cost required to maintain the road in a proper state of repair. The Gilberts gap to Lyons road is recommended for removal to the second class.

The commission would ask that attention may be given at an early date to Delaps and Bath Lodge streams, which might, it is thought, be dealt with under "The water-course act of 1889."

(25) A proposal to create a special class for roads which required an extraordinary

expenditure to maintain was not entertained by the commission, as it was thought the creation of such a class would to some extent be prejudicial to the proper working of the existing road act under which losses on one part of a road are made up by gains on another part, and that it would be better to leave any case in which hardship is shown to exist to be dealt with specially by the legislature.

(26) It was thought prior to the meeting of the commission that some amount of dissatisfaction existed with regard to the working of the present road act, but this has not been shown to be the case; in fact, there would appear to be strong objection to any alteration of its main provisions or principles.

FRED. EVANS, *Chairman.*
JAS. MAGINLEY.
J. FREELAND FOOTE.
ARTHUR W. HOLMES à COURT.
OLIVER NUGENT, JR.
J. SUTHERLAND.
V. GUFFROY.

ST. JOHN'S, ANTIGUA, *June* 16, 1890.

BAHAMAS.

REPORT BY CONSUL M'LAIN, OF NASSAU.

I regret to say that the conditions existing here for the making of roads and streets are so essentially different from anything in our own country that, in my opinion, nothing that I could mention would be of the slightest value to our street builders and road makers.

The Bahama Islands are composed of coralline limestone, and the surface of this natural rock forms the street or roadway. There is no depth of soil, the rock itself being often fully exposed to view. All that is done to construct a street or roadway is to remove such sparse brush or chaparal as may be growing thereon (the rock itself being so porous and full of crevices and fertilizing elements as to sustain considerable vegetable growth with little, if any, soil), smooth down any sharp projections of rock, and fill up depressions with small pieces of the broken stone. As a result you have a reasonably smooth roadway of solid stone, which will meet all the requirements of the people.

In the outlying islands of the colony there are comparatively few roads, and such as exist are little more than pathways cut through the bush, wide enough to permit the passage of a single two-wheeled farm cart, which is about the only vehicle in use. The fact that the islands are generally of considerable length and narrow width renders roadways less necessary, the people owning their boats and passing easily from point to point along the shore.

In the island of New Providence, whereon is situated the capital, the city of Nassau, a town of about 12,000 inhabitants, more attention is paid to streets and roadways, but here, as elsewhere, the solid rock forms the street or road.

The original cost of the streets is not great as there are no difficult

problems of grade, sewerage, or engineering, and the cheapest and rudest form of labor is used in their construction. There are few streams or ravines requiring culverts or bridges.

The limestone rock is comparatively soft, and, in consequence thereof frequent repairs of streets are needed in the city proper. These consist of filling up holes and ruts, and renewing gutters which run along the sides of the streets, emptying into lateral deep drains which, in turn, are discharged into the harbor, a strong tide carrying everything out to sea. In making repairs the material used is the same quality of limestone, broken into small pieces, wetted, and packed smooth by heavy iron rollers, when it rapidly becomes as solid as the best kind of cement. The streets thus made are not particularly hard, but they answer all demands, since nothing known as heavy traffic ever passes over them. The vehicles in use are light carriages, farm carts, and common drays, seldom drawn by more than a single horse each.

The annual expenditure for keeping the streets and roadways of this island in repair is not great, a yearly appropriation of about $7,000 being made for that purpose, by the legislature. There are no road or street taxes collected, as such, in this colony; but all expenses are paid from the general fund, and disbursed by the board of public works. Some work is done upon the streets from time to time by prisoners working in chain gangs, but the value thereof is not very great.

No obstruction to uninterrupted travel ever arises from the wet or muddy condition of streets or roads in the Bahamas, since the soil, where any exists, is too thin and sandy to retain water, and the bed-rock is so porous as to absorb within a few hours the heaviest tropical downpour of rain.

The extent of streets in Nassau is about the same as is found in towns of the same population in the United States; whilst the total length of the roadways, under public control, on the island of New Providence, outside of this city and its immediate suburbs, I should estimate as not to exceed 45 or 50 miles.

The island itself is about 20 miles in length, with an average width of perhaps 5 miles. Two years ago there was less than one-third of the island under cultivation and hence no great need for country roads; but now large tracts are being planted in sisal, for the production of fiber, and new roads are being projected and will shortly be built in all parts of the interior. They will all be of the same general character as those now in existence, and will be easily and cheaply made.

THOS. J. MCLAIN, Jr.,
Consul.

UNITED STATES CONSULATE,
Nassau, N. P. November 28, 1890.

BERMUDA.

REPORT BY CONSUL BECKWITH, OF HAMILTON.

CITY STREETS.

The streets and roads in Bermuda are made and maintained chiefly from the native coral rock of which the islands are composed. The method of making the streets is to cut through the solid rock forming the hills or elevations, making the sides of the cuttings perfectly perpendicular, and cutting down until a suitable grade is established, which is generally made as near the sea level as practicable. This cutting is done by means of large saws, similar to an American cross-cut saw, and the rock being again sawed into smaller blocks it is removed either by blasting or by cutting out with a large iron chisel. This chisel has a length of about 12 feet and a blade about 4 inches in width. These chisels weigh from 12 to 15 pounds and their weight helps greatly in cutting, as they are used after the manner of a "digger" for post holes. The rock is very soft and porous, but hardens on exposure to the weather. The rock removed from these cuts is used in filling in the depressions and hollows until the road is brought up to grade. In certain parts of the islands a sort of limestone exists of harder substance than coral. This limestone the government causes to be collected, taken to the different jails, and there broken up by prisoners, both civil and military, into small pieces about three-quarters of an inch to 1½ inches in diameter. These broken pieces are called "jail nuts." This broken stone is now bought from the government by contractors and spread over the graded road to a depth of 3 or 4 inches. Then a top dressing of small coral rock is put on, which soon crumbles under wear and forms with the limestone an excellent macadam, very smooth, very clean, and very durable. It so readily absorbs the water that mud is unknown here. To repair this kind of road it is only necessary to pick it over to the depth of 2 or 3 inches and add a little broken limestone where there is any great washout or sinking.

The above is the only system of road-making known here and the details of construction are in every case the same as above. The expense of making and maintaining the city streets is borne by the corporation of the town, which hires the necessary men, teams, and foremen or overseers. The expense of watering and sweeping the streets is also borne by the corporation and performed in the same manner.

COUNTRY ROADS OR HIGHWAYS.

The method of making the country roads or highways is exactly the same as that used for city streets, *i. e.*, to cut through the rock forming the hills and elevations with a saw, saw the coral into smaller blocks, and remove the débris by blasting or use of the chisel. This loose rock

is then spread over the hollows and depressions until a suitable grade is established, and a low grade is chiefly used. The same limestone used on the streets is spread on these roads in the same way, and the top dressing of coral on that. These roads are repaired the same as the streets, *i. e.*, by picking them over and adding broken limestone. The expenses for all kinds of road building are chiefly for labor and the cost of the broken stone. A laborer receives $1 per diem, a man with horse and cart $2.50, and the limestone costs about from $1.25 to $1.50 per ton delivered at jail. The expenses of building and maintaining all country roads and public highways, except city streets, are borne by the colonial government, and the work is let out to contractors by bids. In many cases in this class of roads it is impossible to cut directly through a hill or elevation, and the road is then carried around it with the easiest grade practicable, cutting into the sides of the hill where possible to shorten the curves.

The effect of good public roads has been here to greatly increase the value of land, especially that designed for residences, and at present two roads are in process of construction across a marsh hitherto unused, which will probably cause the marsh to be filled up and used as farming land. There are also roads here called military roads, chiefly lying about the British fortifications and camps or leading to them. These roads are built and maintained by the military, the labor being performed by the soldiers. These roads are marked by large mile-stones set up by government surveyors. There is a law in force here tha "any road remaining open for 21 consecutive years becomes a public road and passes under the control of the colony." Therefore to retain the right to control these military roads the British government causes them to be closed for one day in each and every year. This law does not apply to the public highways or city streets.

HENRY W. BECKWITH,
Consul.

UNITED STATES CONSULATE,
Hamilton, Bermuda, December 24, 1890.

JAMAICA.

REPORT BY CONSUL ESTES.

The Macadam system of road-building is used altogether on the streets and "government roads," as the main highways are called, and on the best of the byroads in the plains, but the mountain "parochial roads," usually little better than mere trails or bridle paths, are left to the tender mercies of heavy rains and unskilled labor to a great extent and are far from worthy of any extended notice in this report.

The same system, however, that leads to cut-up and make dusty

streets during the dry season and to flowing rivulets of mud and water in the wet season, under the heavy hauling in some parts of Kingston, yields most excellent driving roads in the outskirts of the city and main highways, far above the average in the western hemisphere, in the country.

The stage routes throughout Jamaica, though used by the peasantry to an unusual degree, are in many places quite equal to many of the trotting tracks of the United States in smoothness of surface and elasticity.

The formation or basis of Jamaica is of igneous rocks, overlying which are several distinct formations, principal among which are the white and yellow limestone or "rotten marls," as they are sometimes called here. These very brittle formations lend themselves readily to road construction, and it is due to their presence near at hand throughout most of the island, combined with the very low scale of wages, that Jamaica is possessed of so excellent a highway.

All the stone used, which is broken to about the standard size of "small stove" coal in the United States, is so reduced by women, who break it piece by piece with a steel hammer, sitting with a pile of boulders in front of them and often working for hours without moving from one spot. For this severe labor they usually are paid, by task-work schedule, about 18 to 24 cents per day. This material is then taken, usually in trays carried on the heads of women and girls, to the road and sprinkled on at such places as the road overseer points out. Some of these women become quite expert and can be left for several days to go on with this work undirected. Here also the same small wages hold.

Steam rollers, road scrapers, road plows, and all other forms of road machinery are unknown here, the shovel, common grubbing hoe, and the machette or cutlass are the only implements used in the grading, surfacing, and cleaning of the roads.

When the broken stone is put on the roads it is left in that condition, the frequent and almost constant traffic over much of their extent sufficing to soon bring the whole to an even surface of a hard but elastic and fine consistency.

Water courses, where small, are for the most part conveyed beneath the roadways in concrete pipes the sections of which are here made of this same material mixed with Portland cement; this more skilled work, usually done by men with women assistants, can be obtained for an average of 50 cents per day.

In this very primitive fashion the inhabitants of Jamaica are enabled to enjoy roads of over 500 miles in extent, circumscribing and intersecting the island, which will compare favorably with the Pullman road of Chicago and the system around the larger Eastern cities of the United States.

To the various parishes, corresponding closely to our counties in the United States, is allotted the care of all such roads as are not of sufficient importance to make them subjects for the care of the colonial government; the main highways, however, are now under the care of the director of public works, who, with the assistance of five district engineers, a government surveyor, and four superintendents of roads, is directly responsible to the Government for their condition.

While the expenditures for main roads are borne on the annual estimates, and are chargeable to the general revenues of the colony, still there is a system of taxes which is ingenious and which contributes in no small degree to swell these revenues.

This system consists of taxing all such articles or animals as in any way contribute to the wear and tear of the roads. Some of these items are as follows:

	£	s.	d.	
Each head of horse kind used on roads	0	11	0	= $2.67
Each head of ass kind used on roads	0	3	0	= .73
Each horse, ass, or other stock not used on roads	0	1	0	= .24
Each wheel of a carriage	0	15	0	= 3.65
Each wheel of a cart	0	6	0	= 1.46
Each wheel of a hackney carriage	1	0	0	= 4.86

The report of the director of public works for 1876 to 1888, inclusive, shows that the average annual expenditure for repairs and maintenance was but $165 per mile. During that time the new works, consisting mainly of new bridges and some entirely new roads, have been about $230,000; this has been for a main road system extending throughout a mountainous island, which is quite adequate to meet the needs of about 800,000 inhabitants in an area of 4,193 square miles, of which only 646 square miles are flat or plain land.

When it is remembered that the extremes of heavy flood rains and of hurricanes have to be contended with, it is generally considered that this is a remarkable showing.

The dry, parched, and rocky bed of a strean on one day may be the course of a roaring torrent, carrying everything before it, on the next day; the clean roadbed of one moment may be strewn with the débris of the mountain hurricane but a few moments after.

While these are not frequent causes of extra outlay, they did call for an increase of about 25 per cent. in expenditure in 1880 and 1886.

W. R. ESTES,
Consul.

UNITED STATES CONSULATE,
Kingston, Jamaica, December 9, 1890.

TRINIDAD.

PRINTED REPORT TRANSMITTED BY CONSUL PIERCE FEBRUARY 6, 1891.

Practical suggestions for road making by Mr. Devenish, town superintendent of port of Spain.

Before proceeding with the repairs of the roads, an important point should be first determined, viz, the legal breadths of the roads; such breadths to be equally measured from the center of the roadway towards the adjoining fields, except in cases where a road runs along precipices, hills, cliffs, landslips, and river or sea side, etc.

For any road used for the cartage of produce, or first class road, 40 feet should be allowed for the out-and-out width. Of these 40 feet, 30 to be between the inner sides of the trenches.

The width of the other roads of minor importance should be determined by the nature of the locality through which they may pass.

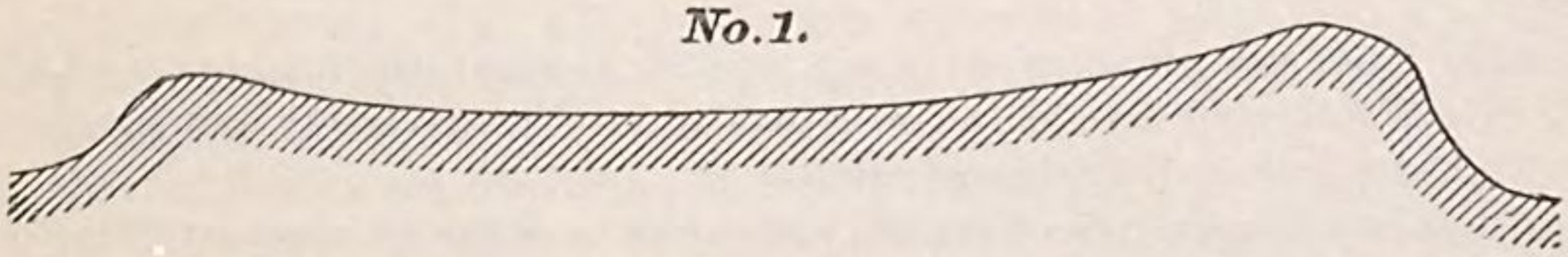
The proper width having been ascertained and determined, a space of at least 4 feet on each side of the road should be kept free from plantations, bush, or live fences, so as to allow to the road the full benefit of wind and sunshine.

Previous to attempting any metaling, or, in fact, any general repairs on a road, the greatest attention must be paid to its proper cross-sections and drainage.

The roadway should be carefully and evenly sloped from the center to the trenches at an inclination of from 3 to 4 inches in every 10 feet, as local circumstances may direct.

The general shape of the old roads which are to be brought to a true cross-section is as follows, viz:

No. 1.



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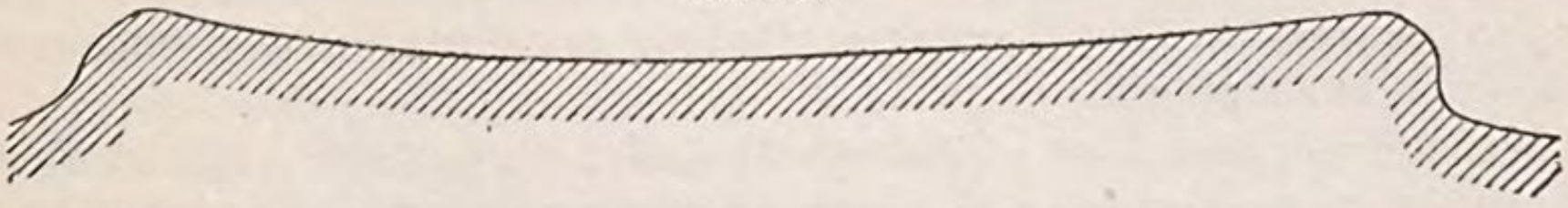

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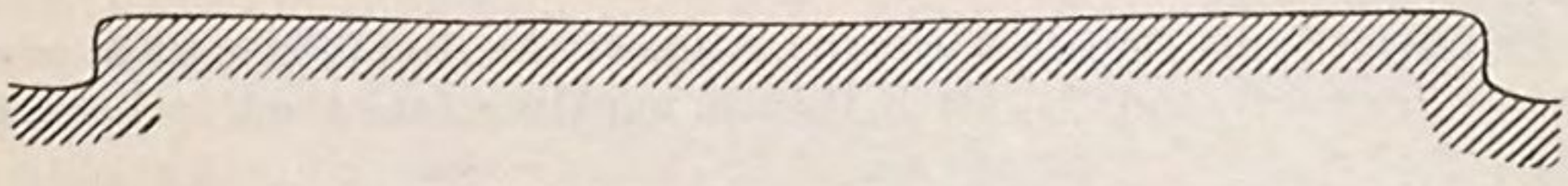
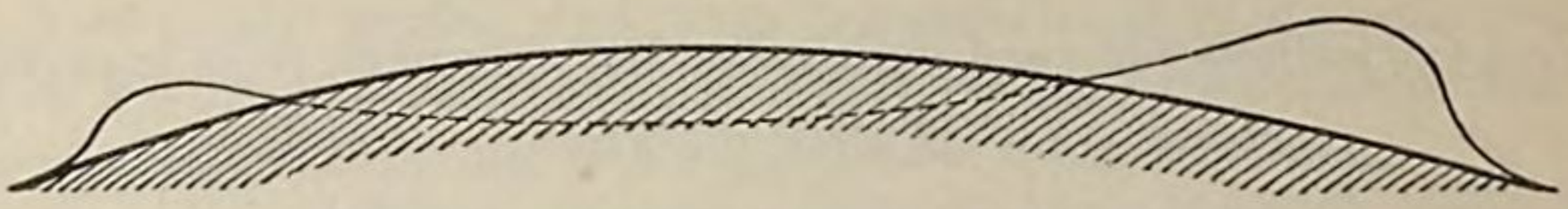


The most economical, and, in fact, often the only, mode of correcting the vicious shape of such roads when they have never been coated is—

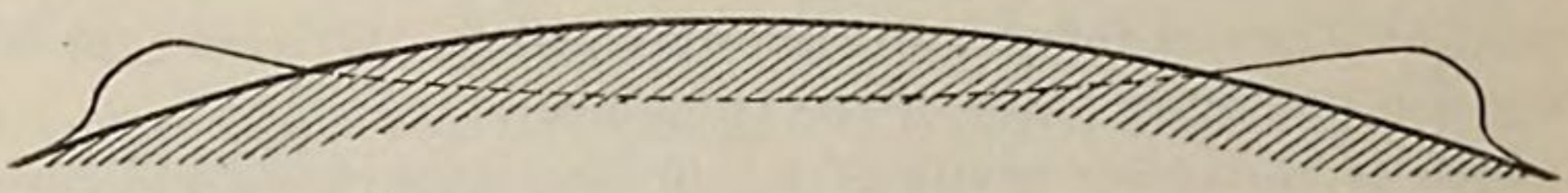
In No. 1, by raising the lower side and forming the section with the cuttings from the higher one, thus:

No. 1.



And in Nos 2 and 3, by filling up and raising the center with the earth taken from the sloping of the sides and digging out of the drains, thus:

No. 2.



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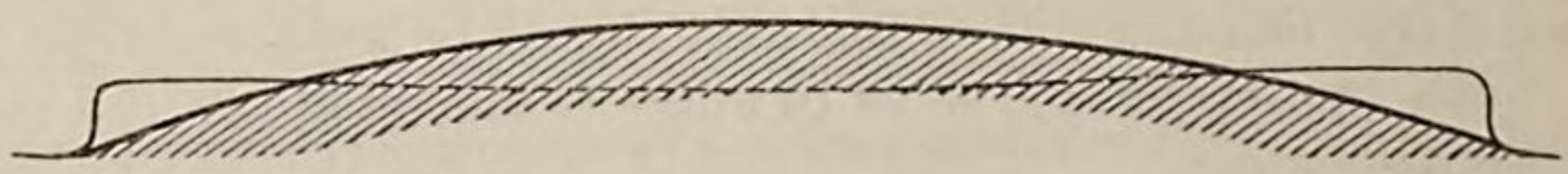

The earth thus thrown on the road should never be allowed to lie in large clods, but should be well broken and rammed down as much as possible.

It sometimes happens in case No. 1, when the road has been long metaled, that there is on the higher side almost enough metal, if not to correct entirely the section, at least to help much in doing so.

In no case, however, should a graveled road be thus brought to a true convexity with mere earth thrown on the coated surface.

In graveling roads the proper shape must then be attained by throwing the cuttings off the road and by gradually raising the lower side by repeated layers of gravel or metal.

In very low and soft places, when brush wood is at hand, the road is very advantageously raised by laying fascines or even logs of wood transversely and covering the same with at least 12 or 15 inches of earth.

The all-important operation of drainage requires next the greatest attention on the part of those in charge of the roads.

It must generally be carried on simultaneously with the forming of the road, as the earth taken from the side channels is often the principal means of raising the bed of the road and of shaping it.

From actual experience I am of opinion that the edge of the angle of the drains with the roadway, owing to the very careless driving on our roads, should be sloped off thus , so as not to be injured by the wheels of vehicles coming too near the drains.

When this angle is not sloped off the inner side of the drains in most of our roads is constantly destroyed, and the earth thereof tumbling into the trenches soon fills them up.

On roads where I have thus sloped the drain-side nearly 5 years ago the trenches and sides of the roads are still almost as perfectly shaped as when first made, and the expense of cleaning the drains has been infinitely less than when the angle is retained.

The outer side of the trenches should be carefully sloped according to the nature of the soil.

In the clayey soil of the Naparimas the slope should never be under an angle of 45°, that is, 1 foot horizontal to 1 foot perpendicular for cuttings under 2 or 3 feet, but for a greater height, to prevent landslips, it should never be less than an angle of 30°, or 1¾ feet horizontal to 1 perpendicular.

In cuttings, such as in the light sandy Tacarigua soil, a far steeper slope will do, such as one-half foot, and even one-fourth, to 1 foot.

The depths of the side channels must of course depend a good deal on local conditions, but great attention should be paid not to make them unnecessarily deep, and more particularly not to give them too great a longitudinal inclination.

This is a fault often committed in the side trenches of many of our roads, principally along hill slopes, where, on the contrary, it should be most carefully avoided.

Too much inclination causes a strong current and a rush of water that soon undermines and destroys the sides of the drains and very materially damages the road.

On hilly roads, therefore, the drains ought to be dug deeper at the highest point and their depths gradually lessened in going downward, so as to correct in some measure the natural declivity of the ground.

When the road is very steep the channels are sometimes advantageously cut like steps at convenient distances in order to give them a more gentle inclination. But whenever this is done stones must be carefully hand-laid on a few feet immediately under the fall of the water to prevent it from digging and destroying the bottom of the lower drain.

Whenever a road runs along the side of a hill the greatest care must be taken to prevent the hill water from overflowing the upper drain and running across the surface of the road.

In such cases cross underdrains made of hard wood or masonry must be established at conveniently short distances all along the hillside and their lower end carried always at least 5 or 6 feet beyond the breadth of the road.

The inlet or upper ends of such cross drains should always be protected by either hardwood posts and planks or by small wing walls, and great care taken that they are never choked with weeds, trash, or any rubbish carried by the water.

An inclination of 1 inch in 10 feet is enough for such cross drains. Their diameter must be regulated by the locality, but in general drains 2 feet wide by 18 inches deep will be found large enough.

In covered drains made of hardwood I have found it very advantageous to bore one or two rows auger holes in the top planks and also along the sides, 8 or 9 inches above the bottom. These holes help a good deal in drying up the subsoil all around the cross drains.

Catchwater drains are also often indispensable on the upper side of the slope to catch the hill-water and carry it into the inlets of the cross covered drains, thus preventing too great a rush of water into the upper side channels.

Small but numerous outlets, and in low, level ground larger ones, or main side drains to carry the water from the side channels to the adjoining fields, or into the natural water-courses, when near enough, should be regularly established at moderate distances along a line of road, and always kept well clear and open.

In no case whatever should the proprietors or occupiers of land along the road be allowed to drain their fields into the side channels of the roads. They should be compelled by law to bring such water into a main drain parallel to the road, and which would carry it to some lower points or to some natural water courses.

Whenever springs are met with in a road the place should be dug right down to the very spring, and a deep channel cut thence across the road and filled up with either large broken stone, or logs of wood covered with a foot or 18 inches of earth or road materials, as the case may be.

After a road shall have been well shaped and drained, and in no instance till then,

the surface of the roadway must (when practicable), be coated with the best suited materials at hand.

In this colony, where, owing the very small and inadequate amount of capital available for making and repairing our roads, it is not probable that the most approved system of road making in the mother country can be carried out, at least for many years to come, it behooves us to see in what manner we can turn our resources or means to the best possible advantage.

If the road to be graveled is an earth road (that is, never coated) or newly shaped road, the surface must first be allowed to be sufficiently rammed down, either by the traffic or with heavy "rammers," until it becomes consolidated enough to receive the gravel or metal.

When this is done the gravel or metal must then be carefully spread on a width of 15 feet, at equal distances from the side channels, first in a layer 4 inches thick throughout.

After this first layer shall have been sufficiently compressed and settled (which will happen in very few days on a road with any traffic), then a second coat of 4 inches again is to be laid over it, and also allowed to settle for a few days, when a third and top course, also 4 inches thick, will be applied to complete the work, thus giving a total depth of 12 inches to the crust of the road, or 55½, say 56, cubic yards, of materials per every 100 feet of road in length.

During this process laborers should be employed to rake the several courses as evenly as possible to prevent the formation of any ruts or holes and spreading of the materials beyond the proper width.

The foregoing thickness is particularly recommended for gravel taken from the San Fernando pits, or from the beds of rivers and ravines, but for the metal from the quarries about Port of Spain, St. Joseph, or Glenroy a thickness of 8 or 10 inches laid in two or three courses will, I believe, be quite sufficient if carefully applied.

When round clear pebbles are used a small proportion of chalk, marl, loam, or fine gravel should be well mixed with the pebbles in order to bind them and to prevent their constant fretting and rolling against each other.

Although the process recommended above of laying three different courses will, likely, be very unpopular at first with contractors, yet I have no doubt that ere long they will find how beneficial it is for themselves by making their work much superior to that formerly done under the old system, almost without increase of expenditure, and by doing away with the unpleasant squabbling and difficulties so frequently arising before in consequence of bad work.

When broken stones are used care should be taken that their sizes never exceed 2½ inches. This is easily obtained by passing the metal through sieves with bars 2½ inches apart. The last or top course might be made of finer stones, but in no case whatsoever should large stones be allowed to be placed on the road.

During the metaling of any portion of a road proper measures should be taken to force the carts and carriages to pass, in turn, over every part thus newly metaled. This may easily be effected by placing heaps of stones at convenient places.

Depots of gravel or metal of 25 cubic yards each should be established at every one-fourth mile, and special laborers constantly employed in preventing the formation of any holes, ruts, or inequalities, etc.

The best time of the year for repairing the roads is the latter end of both the dry and rainy seasons.

At the end of the dry season the cross sections should be carefully corrected, the surface scraped, regraveled, and put in thorough order, the side trenches, outlets, main and catchwater drains properly cleansed, scraped, and reopened wherever necessary; the bridges* and cross-covered drains overhauled, cleared, and repaired; the depots of metal well filled up; the sides of the road cutlassed or better mowed,

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* All wooden bridges should be made of country hardwood, and white and pitch pine at once excluded from such works.

and, in fact, the road must be made ready to stand the effects of the heavy rains during the coming wet weather.

At the latter period the damage done during the wet season must be repaired without delay, the bridges and cross-covered drains examined and put to rights, the weak parts of the road reloaded with metal, and the road, in a word, must be again thoroughly overhauled and prepared to stand the heavy cartage of the ensuing crop season.

The sides of the roads should be regularly cutlassed or mowed four times a year, so as to insure at the nearest possible period the growth and formation of a low and thick green sward instead of the long grass and numerous weeds of all sorts that are now spoiling the appearance of most of our roads.

As soon as the frequent use of the cutlass shall have destroyed the brush on the sides of the roads the scythe must afterwards be exclusively used.

It does a much neater and cheaper work than the cutlass, and does not so much tear up and disturb the roots of the grass.

All grass and brush cut on the roads should be carefully removed.

No mud bank, scrapings, or rubbish of any kind should be allowed to remain on the sides of the roads.

The drains must, at all times of the year, be kept free from grass and rubbish, and the parties in charge of the roads should pay great attention to prevent the constant choking up of the channels with cane trash and plants, manure, etc., as is now practiced along most of the roads running through sugar estates, particularly at the junction of private roads or cane traces with the high road.

They should also take good care that the lopping of trees and clipping of live hedges be regularly attended to as prescribed by the road ordinance.

Generally speaking, all repairs of any importance should be given out by contract, and clauses entered in the deed of contract to provide for the faithful performance of the work within a fixed period, under penalties to be guaranteed by sureties.

Perhaps the best way would be to have printed blank forms for the different sorts of contracts generally to be entered into for the repairing and keeping of the roads.

Instead of relying entirely on tenders to know what repairs will cost, as is generally if not always the case now, the parties in charge of the roads should always, previous to calling for tenders, make, or cause to be made, a careful and correct estimate of what such repairs are worth, and being thus well acquainted with the value of the work to be done should never allow themselves to be taken in by the low figure of an ignorant contractor, but only accept of such contracts as are within a fair range and likely to prove remunerative.

SYL. DEVENISH, *Secretary.*

ASPHALTING OF STREETS.

TOWN SUPERINTENDENT'S OFFICE,
Port of Spain, Trinidad, June 24, 1890.

In regard to the results, etc., of the asphalting some of our streets I have the honor to submit the following brief notes on the matter:

(1) I am of opinion that the laying of asphalt is an immense advantage over the common macadamizing, and there is every reason to believe that it will last many years at a small cost of keeping. The principal advantages are:

(*a*) To be almost noiseless and offer very little resistance to traction.

(*b*) To be free from mud in the rainy season and from dust in the dry season.

(*c*) To offer good sanitary conditions without emitting any perceptible unpleasant smell.

(2) Hitherto we have used asphalt in its crude state, pulverized by hand with cast-iron rammers and applied cold on our already macadamized streets, on which it is

either rammed as above or rolled by steam, and I am convinced this is quite sufficient and will answer well here, instead of having recourse to the complicated and expensive system followed in America, where the asphalt is boiled, etc., and laid at a cost of about $4.50 per square yard. (See the interesting and exhaustive pamphlet "Genuine Trinidad Asphalt," published in Washington by the Barber Asphalt Paving Company.)

(3) Of course our asphalt street work is as yet in its infancy and only an experiment, in which we must necessarily gradually gain experience, and it remains to be seen what will be the ultimate results.

(4) The principal cause of complaint against it, and I believe it to be the only one (cost excepted), is its great slipperiness in streets in which, owing to the high level of our tramways, a much over curved cross section has been unavoidable, but in other streets this complaint has scarcely ground to go upon.

(5) The advantage we have here is that our streets, being almost all macadamized, it only requires a scooping out of a few inches, and the ground below is generally firm and hard enough from the lower remaining macadam to receive a mere top dressing of about 2 to 3 inches of pulverized asphalt.

(6) The asphalting of our streets will, in future, be much improved from our past experience, and I have no doubt that it will give universal satisfaction and will prove a great boon to our town.

(7) It is my intention to try, if allowed to do so, a small proportion of fine sand to be mixed with the asphalt, so as to render the surface a little gritty, and do away with the present sleekness to which, however, our horses are gradually getting accustomed.

(8) The facility of procuring asphalt from our pitch lake at 10 a ton, delivered on the wharf, is, it must be said, a great deal in our favor, whilst in Demerara the cost will necessarily be much greater.

(9) On a rough calculation it takes us about 3⅜ cart loads (of 12 cubic feet each) of asphalt to the ton.

(10) One such load will cover about 50 square feet or 5.55 square yards from 2 to 2½ inches thick.

(11) The average cost of working our steam-roller is about $5.35 per diem.

(12) Hitherto the steam-roller has only been able to roll about 666 square yards daily, but more will, no doubt, be got out of it in future.

(13) We calculate that it takes during 10 to 12 days ten or twelve laborers daily employed in digging, pulverizing, and laying for preparing sufficient pitch for 2 days steady steam-rolling.

(14) One hundred square yards of asphalting has cost us in the southern division of the town, where the traffic is very great and the streets consequently much worn out, $37.58, whilst metal and sand would only cost about $20, or about 52 per cent. less, but for work not to be compared with the new coating.

(15) In the northern division we have slightly asphalted, under much better conditions, 9,601.68 square yards of streets at an average cost of about 25 cents per yard, but with the intended improvements I believe this may probably be increased to 35 cents.

(16) The use of asphalt is particularly of the greatest advantage in protecting the sides of the roadway and the corners of the streets, where the rush of storm water in heavy rains constantly washes away the macadam and digs deep furrows and holes.

SYL. DEVENISH,
Town Supt.

DANISH WEST INDIES.

ST. THOMAS.

REPORT BY CONSUL HORNE.

CITY STREETS.

The local government is unable to give me the estimated cost of making or repairing the streets of this city, *i. e.*, "Charlotte Amelia." They were made, of broken stone, upwards of a century ago, and are kept in repair by using similar material, the stone being broken fine by convict labor. The depth of the broken stone is about 20 inches. The streets are slightly oval and smooth and of great solidity. As they are not subject to either frost or heavy traffic, the annual expense of keeping them in repair is very small. Convict labor is utilized in breaking stone and keeping in repair the city streets and such portion of the country roads as are necessary for use. The streets are substantially bordered on either side by gutters made of irregularly-shaped but nearly flat stone, which are laid in and evened up by a hard cement. The sidewalks are mostly composed of material, similar to those employed in making the gutters.

COUNTRY ROADS AND HIGHWAYS.

There is no "ordinance" governing the making or repairing roads and highways in this island (Saint Thomas). The abandonment of the estates, following soon after the emancipation of the slaves, has caused the country roads to fall into disuse. Country traffic has practically ceased and the roads are but little used.

I inclose herewith a copy of the "ordinance concerning public roads in St. Croix." It contains all the information which Mr. Moore, the consular agent there, has been able to obtain on the subject of streets and highways.

SAMUEL B. HORNE,
Consul.

UNITED STATES CONSULATE,
St. Thomas, January, 14, 1891.

ST. CROIX.

OFFICIAL ORDINANCE TRANSMITTED BY CONSUL HORNE, OF ST. THOMAS.

I. GENERAL PROVISIONS.

§ 1. The public roads in St. Croix are divided in two classes: (1) Main roads, the width of which between the trenches shall as a rule not be less than 36 feet, with graveled roadway not less than 14-18 feet in width; and (2) by-roads, the width of

which between the trenches shall as a rule not be less than 24 feet, with roadway not less than 10-14 feet in width.

§ 2. A list of existing roads of both classes shall be issued by the superior authority and published in "St. Croix Avis."

Upon agreement to that effect with the colonial council, government may include new roads among the number of the existing pubilc roads, or discontinue existing public roads as such, which alteration shall be published in the same manner.

§ 3. The superior authority is empowered to grant permission to lay down tramways on the public roads, subject to such stipulations as are requisite to insure that the general traffic be not hindered, and that the parties having to discharge the repairs of the roads do not by such tramways get increased burden of road work.

§ 4. Quarter lines as well as private roads of communication between estates shall generally be 24 feet in width and shall be kept open and in good order to same extent as hitherto.

II. Control with the Roads.

§ 5. The public control with the roads is exercised through a road commission, consisting of a chairman, appointed by the superior authority, and eight members, half of them elected by the superior authority, the other half by the colonial council, in such wise that for each of the eight quarters of the island one member is chosen from among the residents of the quarter, as a rule from among the proprietors of landed estates. The election shall be for a term of 5 years, but only the half of the number of members shall retire at a time. Five members shall constitute a quorum. The superior authority is empowered, whenever it be deemed necessary, to dissolve the road commission and to cause new election to be held.

§ 6. The control with the state of the roads in each quarter shall be performed by the member of the road commission appointed for the quarter, who has to make the necessary reports to the chairman. To assist the members of the commission there shall be appointed such a number of road inspectors as the superior authority upon representation of the commission shall at any time find necessary.

§ 7. Every owner, administrator, or manager of an estate who has not completed his 60th year is obliged to accept election as member of the road commission or appointment as road inspector, unless the superior authority or the colonial council, if he has been elected by this latter, on his application to that effect, should find cause to exempt him. The road inspectors are appointed for a term of five years, at the expiration of which they are during a term of the same length entitled to exemption from such charge.

§ 8. The chairman of the road commission is salaried with $300 p. a. The road inspectors shall receive a compensation of $32 p. a. each.

§ 9. The duties of road officers are to be fixed and defined by instructions issued by the superior authority; which instructions shall also contain the necessary rules for the business routine of the road commission, for the election of members of the commission, etc.

III. The Road Work.

§ 10. The duty of keeping the roads in every quarter in good and serviceable condition is incumbent on the owners of landed properties, factories, and similar establishments situated within the quarter. The works required for that purpose are effected in such a manner as shall be prescibed in regulations issued by Government upon conference with the colonial council.

§ 11. By means of assignment to be effected every fifth year, every property is assigned the allotment of roads which is incumbent on the property to keep in repair.

The assignment in which should be considered the quality and location of each allotment, if it is part of a main road or of a by-road, if it is particularly easy or

difficult to keep in repair, if it contains water courses or not, etc., is made in proportion to the matriculated acreage in cultivation of the respective properties in such a manner that one acre of land in sugar cultivation is considered equal to 5 acres in other cultivation, and that no land is exempted, except land from which no use or benefit whatever is derived. The road work incumbent on factories and similar establishments is fixed by the superior authority.

The maintenance of the pavement or the bridge of a water course, or other more extensive works of repair, may be assigned to several estates jointly. Likewise any work of repair may be assigned several estates jointly, provided these estates are so small that it would be inexpedient to assign to each a separate work of repair.

§ 12. For each quarter separately a draft of the assignment is drawn up by the respective member of the road commission in conjunction with the road-inspectors of the quarter, and is transmitted before the 1st July in the year in question, to the road commission, who, on the basis of the drafts, draws up a draft of assignment for the whole island, which draft shall be transmitted in duplicate to the superior authority before the 1st August, and the said authority thereupon, by publication three times repeated in the newspaper of the island, shall inform the parties concerned that copies of the assignment have been placed for inspection in the police offices, and eventual objections to the assignment must be made within 14 days of the last publication. On the expiration of this term, the superior authority decides on the objections that have been sent in after having taken the opinion of the road commission and confirms the assignment according to such decision, upon which one copy of the assignment is transmitted to the road commission, who, through the members of the road commission and road inspectors, conveys information to all concerned of the allotment of road assigned to each property.

The bounds of the different allotments shall be exactly indicated, before the 1st October, by conspicuous posts bearing the mark of the property and planted by the roadside.

§ 13. The public roads, with bridges, courses, breastwalls, handrails, etc., thereon found shall undergo general repairs every year, such repairs to commence the 1st October and to be completed before the 31st December.

§ 14. Every year in the course of the month of January a general inspection of the road works takes place, to be held for every quarter by two members of the road commission and two road inspectors, all of whom are appointed for the purpose by the chairman of the commission, and must be residents of another quarter.

The member of the commission for the quarter to be inspected shall however receive notice to be present at the inspection; he is entitled to point out defects, but has no vote in the decision,

§ 15. When defects in the road work are discovered by the inspection, there shall be given the holder of the allotment, who is, moreover, liable to penalty under § 24, a suitable term, within which he is to have the defects remedied. Should he find himself aggrieved by the decision of the inspectors, he may within 8 days demand a reinspection, which is effected by the road commission, with exception of the two members, who had taken part in the first inspection, and at which the party shall eventually be given the further necessary term. The decision of the reinspection settles the matter.

If the defects are not remedied at the expiration of the term, the road commission shall, on the report from the inspectors in case no reinspection has been held, have the work done at the expense of the concerned party. The expenses for the purpose inclusive of such remuneration for the controlling member as may be fixed by the superior authority on the representation of the commission, are to be enforced by levy, unless the holder of the allotment alleges that the work is not incumbent on him, that the above mentioned term had not been given him or he advances any other similar objection, in which case the decision shall be given under a public police suit instituted against him.

§ 16. Besides the yearly general repairs such repairs as shall be needful for keeping the roads in a proper state—such as filling up of small holes, leveling the surface, repairs of side-walls, bridges, and the pavement of water courses—shall be effected at all times of the year, when ordered by the member of the road commission. The order so given, and for the fulfillment of which a suitable term shall be allowed, is final when the cost of the work does not exceed $5, otherwise the party concerned may within 4 days demand that the case be submitted to two other members of the commission, chosen by the chairman in conjunction with the first-named member; their decision, whereby eventually the necessary additional term is allowed, settles the matter. If the defects are not remedied at the expiration of the term, the road commission shall, on report to the same, have the work done at the expense of the concerned party. The expenses for this purpose, inclusive of a remuneration to the controlling member fixed in the same manner as prescribed above in §15, may be enforced in the manner prescribed in § 15.

§ 17. When bridges and considerable lengths of road, the maintenance of which devolves upon any single party, are so extensively damaged by heavy rains that the road commission finds it inconsistent with equity to charge him with the repairs, such repairs shall be distributed among the properties in the quarter in the same proportion as the road allotments. Under extraordinary circumstances the public may, however, according to decision of the superior authority, assume the repairs entirely or in part.

§ 18. Whenever a work of repairing is incumbent on several properties jointly, the work is under the direction of the member of the road commission or such person as the chairman of the road commission may depute. Otherwise, the allotment holders are at liberty to consult their own convenience as to the most suitable manner of promoting the work, which, notably, may be given in job, but such arrangement does not affect the allotment holder's responsibility to the public.

§ 19. Should any holder of a road allotment prefer that the repairing of the allotment assigned to him be effected by public agency, and he addresses written application to that effect to the road commission, the work in question will, by order of the commission, be effected by and under the direction of the road inspector of the district, on condition that the applicant, when the work is completed and approved by the inspection, pays the expense of the work, including a suitable remuneration to the road inspector who has superintended the work.

The account of the expenses incurred is forwarded to the superior authority by the road commission who at the same time makes proposal as to the remuneration which should be allowed the road inspector.

When subsequently, all the expenses have been approved, the superior authority assigns the account for payment against the holder of the road allotment, who is bound to pay the amount into the colonial treasury within 14 days. In regard to the payment of the amount in queotion, the colonial treasury holds the same right of levy and preference as it holds for taxes.

For temporarily defraying the amounts for these, as well as for the works mentioned in §§ 15 and 16, the necessary advances may be assigned to the road commission from the colonial treasury.

§ 20. The construction of new roads is effected and expenses defrayed by the public. The maintenace of such a new road devolves upon the road allotments of the quarter in proportion to be fixed by additional assignment.

§ 21. The public is charged with making provision that the necessary gravel pits are to be found as near as possible to the road.

In default of amicable arrangement with the owner regarding compensation for the use of the ground at gravel pit, the area required for the site of the gravel pit, and needful access thereto, shall be expropriated and the value thereof fixed by two experienced and impartial men appointed by the court, in such a manner that each of the interested parties shall have access, before the legislation of the appraisement,

to demand reappraisement by the double number of men. The expenses of the appraisement are defrayed by the public in such a manner, however, that the expenses of a reappraisement demanded by the owner and the issue of which is against him are defrayed by the owner.

§ 22. The same proceeding is applicable in the case of cession of ground for the construction of new roads.

IV. Penalties, etc.

§ 23. Neglect of duty and disciplinary offenses on the part of road officers are punished, in so far as they are not liable to more severe penalties, with fines of not less than $5 and not exceeding $25, which accrue to the colonial treasury. The fines are dictated by the superior authority. In regard to other offenses committed by road functionaries or against such while on duty, the general enactments of law are applicable.

§ 24. Any holder of a road allotment who is found at the annual inspection in the month of January to have omitten to complete the road work incumbent on him, or to have performed it in an unsatisfactory manner, is liable to a fine not exceeding $50.

§ 25. Any holder of a road allotment who fails to comply with an order from the properly qualified officer or auth rity, at any time soever in the year, concerning the repairing of his road allotment or anything belonging thereto, is liable to a fine not exceeding $25. The same fine shall be adjudged against any person omitting to plant the bound posts mentioned in § 12.

§ 26. Cases concerning the offenses mentioned in § § 24 and 25 are dealt with as public police suits, at the instance of the road commission. The road commission, is however, before the case is reported to the policemaster, authorized to accept the delinquent party's offer to settle the matter amicably by fine to be paid forthwith. Concerning such settlements the road commission shall make report to the superior authority. Fines adjudged or agreed to under the present section accrue to the colonial treasury.

§ 27. If the holder of a road allotment is not residing in St. Croix citation in the cases in question may be lawfully served on the person who administrates his property here, with notice to be determined according to the residence of the person thus empowered.

§ 28. On every vehicle which when loaded weighs 3,000 pounds or upwards, the felloes of the wheels shall be at least 3 inches broad. Transgressions of this provision shall be liable to penalty of a fine of not less than $2 and not exceeding $10. Cases of non-compliance are dealt with as public police suits.

§ 29. Upon conference with the colonial council, the superior authority issues regulations containing provisions for the road police and for the maintenance of public peace and security of and on the road, including the preservation of the trees growing along the roads, which trees must not be felled in a space 6 feet from the trenches. Fruit of trees along the public roads belong to the owners of the adjoining properties.

§ 30. Transgressions from the regulations mentioned in § 29 are dealt with in public police suits, and are punished with fines not exceeding $50, which accrue to the police fund. In the case of children under 15 years the punishment of flogging with a rod may be inflicted according to circumstances.

DUTCH WEST INDIES.

CURAÇOA.

REPORT BY CONSUL SMITH.

CITY STREETS.

The island of Curaçoa, being of coral formation, with very little soil, makes the building of smooth and level streets easy, and when built they can be maintained at a small expense.

In places where there is not a solid roadbed of stones, or the surface is uneven, the way is laid out and covered with clay, and over this a paving of coral stones is placed. The stones used for this purpose are taken from the shores of the island, and will average about 6 inches in diameter, and are round in shape. They are broken in suitable lengths, placed on end and driven into the clay, made soft by water to receive them.

These small paving stones are confined within the line of the street by a border of large square or flat stones, and when driven by wooden drivers they are wedged together so that they can not be removed easily; sand is then placed over the surface and sifted into the crevices.

This makes a fine street where there is no heavy traffic, but the coral is too soft to be serviceable where there are heavy teams passing over it.

The cost of such paving here to the government is about $1 per square metre.

COUNTRY ROADS OR HIGHWAYS.

All over the island are estates which are accessible by fine public roads provided and maintained by the government, and under the surveillance of an inspector appointed for that purpose.

The comparative level surface of the island is very favorable for the construction of country roads, no bridging and very little cutting being required. The surface of the road is covered with small broken stones or gravel, and when this is made fine by travel and becomes wet by rains it unites. The roads are made somewhat higher in the center, or turnpiked so that water will not stand on them. There are no rivers or streams for these roads to cross, so no bridges are required, but during very heavy rains large streams of water cross the roads in many places, and water ways are provided therefor. These are made of large, flat stones laid, not like a bridge, but with a concave surface for the water to run over.

The annual expense to the government for the maintenance of these roads is about $2,300, including the salary of an inspector.

L. B. SMITH,
Consul.

UNITED STATES CONSULATE,
Curaçoa, January 29, 1891.

SPANISH WEST INDIES.

PORTO RICO.

REPORT BY CONSUL STEWART, OF SAN JUAN.

STREETS OF SAN JUAN.

The streets of this city are very narrow, and are paved with small, round stones. The sewerage consists (with the exception of a portion of two or three of the most principal streets having underground sewers) of small gutters in the center of the streets, formed by a slight downward slope from each sidewalk. With the exception of this slope the sidewalks are on a level with the rest of the street. The crevices between the round stones are not filled, therefore the streets are very rough, and neither beasts nor vehicles are spared upon them for any great length of time.

COUNTRY ROADS.

In the entire island there are about 150 miles of excellent road, and of this alone it is necessary to speak, since this is all that receives any attention. In its construction a level foundation is sought, and upon this is put a heavy layer of crushed rock and brick, which, after having been well packed and rounded, is covered with a layer of earth. This is then well packed also, and upon the whole is spread a layer of ground limestone, which is pressed and rolled until it forms almost a glossy surface. This makes an excellent road here, where the climate is such that it does not affect it, and where there is no heavy traffic; but these conditions being changed, the road, it is thought, would not stand so well; hence further particulars are deemed useless.

L. R. STEWART,
Consul.

UNITED STATES CONSULATE,
San Juan, December 30, 1890.

SANTIAGO DE CUBA.

The only thing that saves this city and allows carriages and native horses to pass the lanes and roads, by courtesy called streets, is the composition of the soil, viz, decomposed coral rock, in which lime forms a large percentage. The streets are in a deplorable condition; the city being bankrupt, nothing is done to improve them. The country roads are mere trails, impassable in the rainy season.

OTTO E. REIMER,
Consul.

UNITED STATES CONSULATE,
Santiago de Cuba, December 6, 1890.

FRENCH WEST INDIES.

GUADELOUPE.

REPORT BY CONSUL BARTLETT.

The colonial or county roads are built and kept in repair at the expense of the Colonial Government. If a new road is to be built, all the loose earth is removed until they reach a hard substantial surface, then it is filled in with broken stone, about the size of eggs, and beat down thoroughly with mauls, and then fine, dry earth is spread on same, enough to cover them about a couple of inches, and again beat down thoroughly. This is generally let out to contractors.

The expense for building new country roads is about 10,000 francs per kilometre, and to keep the same in repair, it costs about 1,000 francs per annum per kilometre. The center of the streets in the city is made in the same way as the colonial roads, with the addition of 1 metre in width, on each side of the streets running down to the gutters, which is made with broken stones, laid in cement, at an additional cost of about 36 francs per cubic metre. The stone flagging for the sidewalks of the streets, if in artificial stone, costs 16 francs per running metre. The stone to be 35 centimetres wide and 15 deep; if the flagging is of calcareous stone, which is easy to work, it costs 140 francs per cubic metre; if composed of volcanic stone, which is very hard and very difficult to work, 200 francs per cubic meter. The street once built, the expense for keeping them in repair is about the same as colonial roads.

I will mention here that the expense of 10,000 francs per kilometre, for new country roads, is exclusive of bridges and culverts.

The quay of the city of Pointe-à-Pître, where the principal commercial business is carried on, is paved with cobblestones of a volcanic nature, gathered from Guadeloupe proper, at a cost of 4 francs per square metre, and the expense for maintenance is about 2 francs per annum per square metre.

Government or public roads going through properties naturally augment their value.

The principal government roads are very fine and are kept in good repair; but there are very few of them: There is one, extending 66 kilometres, from Pointe-à-Pître Grande-Terre to Basse-Terre Guadeloupe proper, by crossing the Rivière-Salée in a ferry, passing through Petit Bourg, Goyave, Sainte Marie, Capesterre, Trois-Rivières and Gourbeyre; another 120 kilometres long, after crossing the Rivièrre Salée, goes by the northern part of Guadeloupe, to Basse-Terre, passing through Baie-Mahaulto, Lamentin, Sainte-Rose, Pointe-Noire, Deshaies, Vieux-Habitants, Bouillante, and Baillif. There is a short public road from Basse-Terre to Matouba, of about 10 kilometres, passing through the Camp Jacob. There is another short one, recently con-

structed by disciplined soldiers, from Camp Jacob across to Gourbeyre from 4 to 5 kilometres in length.

There is a Government or public road going from Pointe-à-Pître to the Moule, passing through Gosier, Sainte-Anne and Saint-Francois of 50 kilometres, and another one going from Pointe-à-Pître to the Moule, passing through Abymes, Morne-à-l'Eau or Gripon of 30 kilometres and one from Gripon to Anse-Bertrand of 20 kilometres, passing by Port Louis.

These are all the principal public roads existing in Guadeloupe proper and Grande-Terre.

The planters, for their own convenience, make their own roads to their different estates, and at their own expense. Generally these by-roads are not kept in very good repair.

CHARLES BARTLETT,
Consul.

UNITED STATES CONSULATE,
Guadeloupe, July 7, 1891.

CONTINENT OF ASIA.

BRITISH ASIA.

BOMBAY.

REPORT OF VICE-CONSUL BODE.

I have the honor to send herewith a copy of a report from the executive engineer, Bombay municipality, on the subject of street building and road making, as per circular, dated November 8, 1890.

A. E. BODE,
Vice-Consul.

UNITED STATES CONSULATE,
Bombay, April 23, 1891.

MUNICIPALITY OF BOMBAY.

B.

Mr. Walton, engineer, to Vice-Consul Bode.

BOMBAY, *April* 6, 1891.

H. A. ACWORTH, Esq., C. S.,
Municipal Commissioner.

ROADMAKING.

In making new roads the earthwork is first prepared with a surface fall of 1 in 40 from the center to the sides where the width of the road is 40 feet and under. Where the width of the road is greater than 40 feet a fall of 1 in 50 is used. The surface is consolidated with 4 or 5 ton bullock rollers, or with steam rollers, preferably with the latter in the dry season. On this a layer of dry rubble packing of a thickness of 9 inches to 12 inches in the case of the roads of the first two classes, and of 6 inches in that of the others is hand packed solid. Over this are laid two layers of 2-inch road metal in aggregate from 6 to 12 inches in thickness, according to the traffic and importance of the road. The first layer is thoroughly watered and rolled until it is partially consolidated. The second layer is then spread and watered and rolled with steam rollers until the whole is fairly consolidated. About half an inch of loose sandstone * is then spread on the surface of the road and steam rolling is continued and hard level surface is the result. On each side of the road, especially where there are footpaths, bluestone, chisel dressed water table stones 4 inches thick and from 15 to 18 inches wide are laid to carry away the storm water into proper masonry gully-traps. Roads thus made wear under heavy traffic about six years without any extensive repair.

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*A soft littoral concrete.

MAINTENANCE AND REPAIR.

In order to prevent the metal of these roads becoming loose it is necessary during the dry season to water the roads morning and evening, and to repair slight defects as they appear in the surface promptly. New roads are constructed, as a rule, by contract. Repair works are carried out departmently by a staff engaged for the purpose.

When the road requires thorough repair the surface is picked up in continuous convenient lengths to a depth of about 4 inches for one-half the width of the road at a time in order that the traffic may not be stopped. On an average one native pickman, working 8 hours, picks 200 square feet of metailed road. The old metal if serviceable is separated from the fine stuff (which is rejected) and spread over the picked surface. New road metal is put over this to the required depth, giving the proper slope to the surface. This is consolidated as described of new roads.

The total length of the street in the charge of the municipality is 138¼ miles and the area of the metaled part of such roads is 3,110,605 square yards. Footpaths are not included. The annual cost of maintenance of metaled part of roads is as follows:

	Rupees.
Cost of watering for the nine dry months in the year	93,270
Cost of metal and other materials for street repair	162,000
Cart hire in connection with street repair	92,000
Labor in connection with road repair	95,000
Steam rollers	16,000
Coals and stores and repairs	24,500
Total	482,770

Or 155 rupees per square yard.

The effect on the rate of land fronting a new road was recently well exemplified in the construction of the Ripon road. While taking up land for this road an endeavor was made to purchase frontage lands along the line of this road. But on account of the strenuous oppositions of the owners of the land to part with more land than that required for the road, only a part of the frontages could be purchased. The total area of land purchased was 68,750 square yards, from which, deducting 26,289 square yards required for the road, and 5,157 square yards for cross roads, making a total deduction of 31,446 square yards, there remained a balance of 37,304 square yards available for resale. The cost of land, including compensation, amounted to 163,633 rupees; the cost of road construction and establishment amounted to 65,679 rupees; sale charges amounted to 9,000 rupees, making a total of 238,312 rupees, from which, deducting miscellaneous receipts, rent, sale of materials, amounting to 6,806 rupees, there remained 231,506 rupees as the actual cost of making Ripon road, including also charges for land and compensation to private owners. The land was bought at a price averaging 75 rupees per square yard.

The surplus area was sold by public auction at rates averaging 7.23 rupees per square yard.

In addition to the direct profit made by constructing the Ripon road, revenue of the municipality was increased by the buildings which were built fronting the road after its construction.

The amount of such increase can not, however, be given, even approximately.

RIENZI WALTON,
Executive Engineer, Municipality.

True copy.

W. PEARSON,
Assistant to Commissioner,
E. M. S.

UNITED STATES CONSULATE AT BOMBAY.

CEYLON.

REPORT BY CONSUL MOREY.

Department of State instruction per circular of November 8, 1890, was received here at a period when the furnishing of a truthful and thoroughly reliable report on the roads of Ceylon was beyond my capacity.

Mr. MacBride, the director of public works, had on his accession to office in 1885 adopted a new system (or a modification of his own of the Macadam system, hitherto in vogue) and was working it with great perseverance, despite an amount of public detraction that might well have deterred a less able and determined man.

The fierce diatribes against him and his roads, constantly appearing in the newspapers, if cut out and preserved, would form a large volume of the harshest criticism extant, and there was nothing to offset them in the literary line except his own periodical reports to the Government, all of the facts in which were stoutly denied by the great army of dissentients as soon as they appeared.

I myself at one period feared that Mr. MacBride had fallen upon a wrong system, for the outcry against him was loud and fierce enough to shake the confidence of almost anybody. I knew, however, that Sir Arthur Gordon, the then governor of the colony, who had traveled largely over these roads and was a very keen observer, thoroughly believed in the new system and meant to back Mr. MacBride up in it, through "good and evil report," to the bitter end.

I was also in the way of hearing traveled countrymen of my own express admiration of the excellent roads they found wherever they went in Ceylon, and, as their opinions were bound to be dispassionate, they counted heavily against the local utterances, which after all might be largely due to prejudice, predilection, or what is popularly called conservatism.

On my return to the island from leave in 1890 I found the newspaper war on the roads as fiercely conducted as ever, but there was nevertheless a faint murmur of approval getting into the air, and it gradually got whispered about that Mr. MacBride and his highways had scored.

It was about this period of growing reaction that my instruction to report on roads arrived, and as it was MacBride roads that must form the subject of my report, and said roads, after being decried for years, were now just receiving some approval, I felt bound to await future developments before reporting upon the system.

By the end of the year 1890 the denouement came. The roads were unquestionably good, and they had been built and kept up at a diminished cost, as against the old system, of the large sum of 850,000 rupees per annum. Detraction now ceased, newspapers withheld their philippics, and in some cases even made the amend honorable to Mr. MacBride.

Now was the time to make my report, but alas! Mr. MacBride went away on duty to India, and there remained as data for my guidance only his reports, which the newspapers had contradicted *ad inifinitum*, and which being intended only to meet local requirements scarcely afforded explicitly the information my Government desired.

I was obliged therefore to await Mr. MacBride's return, and on his arrival I waited on him and requested the favor of such data as would enable me to make an intelligent and truthful report. This he kindly agreed to give as soon as he could spare time from his own pressing duties to collect it, and the final result is, the annexed, able, and exhaustive exposition by his pen, which, as I could not add to it profitably a single word of my own, he has courteously allowed me to forward in its entirety.

I would merely add, in conclusion, that the roads in Ceylon attain an altitude of over 6,000 feet above sea-level, and are subject to damage, principally from rains and floods, the rainfall sometimes amounting to 260 inches per annum, and in certain localities 12 inches per diem, and 8 inches have been registered in two hours.

They are, however, exempt from the action of severe frost, for this climate is highly tropical, Ceylon being situated only a few degrees from the equator, say between 5° 56″ and 9° north latitude.

W. MOREY,
Consul.

UNITED STATES CONSULATE,
Colombo, July 8, 1891.

Mr. MacBride to Consul Morey.

COLOMBO, *Ceylon, July,* 2, 1891.

W. MOREY, Esq.,
Consul of the United States of America, Colombo:

SIR: With reference to your visit of May last, and request that I should furnish you with information regarding the construction and maintenance of public roads in Ceylon, and the cost thereof, I have the honor to forward herewith a paper on the subject, which I trust will be found of practical interest to the Department of State concerned.

There is no greater boon to give to a populous country than roads; when we find them outside our doors every day of our lives we look upon them as very ordinary things, and think little of them, but go to any part of Ceylon or to any country where there are no roads and you will find every able-bodied man, and woman, too, turned into a beast of burden. I believe roads confer more good on a people than anything that laws can cause or cure.

The direct revenue of roads is that derived from tolls. In Ceylon it amounts to about 450,000 rupees, but besides they give an impetus to trade and are instrumental in developing the resources of the country.

The policy of the government of Ceylon in regard to its roads is one of efficiency combined with economy, whereby all roads receive equal and adequate attention in proportion to the traffic passing over them.

I am, sir, your most obedient servant,

R. K. MACBRIDE,
Director of Public Works.

ROADS IN CEYLON.

[Report by Mr. MacBride, director of public works in Ceylon.]

The roads of Ceylon are, as a rule, well and solidly constructed, and maintained in a thoroughly efficient state for the traffic they have to bear.

These results are attained by the votes given by the government for such services, and by careful attention to every detail by the department of public works.

It is unnecessary in Ceylon to distinguish between "city streets" and "country roads or highways." The only city in Ceylon is Colombo, with a population of 120,000, scattered over an area of 10 square miles. The roads in Colombo are dealt with in much the same way as those in the country, and cost but little more per square yard for construction or maintenance.

TRACING ROADS.

The line of road to be opened in a new district is located by an experienced engineering surveyor, with a due regard to the traffic to be served. Trial lines are usually run in the first instance with a simple instrument known as a "road tracer," with which gradients can be readily located. The line is then traversed with the theodolite, the traverse connected with trigonometrical stations, and then a longitudinal section and cross-sections every 100 feet are taken with the Dumpy level.

A gradient of 1 inch in 20 is considered the maximum that should be permitted in a first-class road.

Zigzags are only permissible when the features of the country are so rugged and precipitous that their adoption is obviously advantageous; but when adopted, their construction for a radius of 50 from the turn on each side is level. This slightly increases the gradient, but the traffic ascending or descending is steadied on a level roadway at each turn, and the draft animals are thereby relieved of the heavy strain.

Owing to the extremely steep and broken nature of the hill country of Ceylon the roads, as a rule, are in sidelong or double cutting; in the low country, where, due to the heavy rainfall, floods occur almost annually, long embankments with numerous waterways and double cuttings are frequent.

The road trace having been made and approved, and the estimate for its construction framed and passed by the government, the construction proceeds as follows:

Cooly lines or rude huts of wattle and daub walls and thatched roofs are erected at convenient points on or near the line of roadway, attention being given to the water supply and drainage, and gangs of Tamil laborers are employed to cut out the earthwork, blast the rock, and remove bowlders until a roadway of 16 feet in the solid to the gradient laid down on the plans is obtained. At the same time the building of culverts in all ravines and of others to take the side drainage of the road, proceeds. These cross culverts have, as a rule, an opening of 3 feet in height, by 2 wide; they are of dry hammer-dressed rubble masonry. A rough floor, about a foot in thickness, is laid, on which the side walls are built and then cover stones with sufficient bearing are selected and the masonry is carried up to road level, and occasionally finished off with a low parapet wall. The larger streams have two, three, or more openings and of longer size and, if 12 feet or more waterway is required, arched bridges of masonry or iron girder bridges with buckled-plated and concrete platforms are used. Partially worn out rails from the government railway have also been extensively used for bridging these smaller streams. Timber, some years ago extensively used for bridging, is now seldom adopted, owing to the extremely rapid decay, of such material in the tropics, and the destruction by white ants to which it is exposed. The larger streams and rivers are bridged, usually, with iron girders, of which very numerous patterns have been adopted in different localities, some imported from England and many made in the public works factory in Colombo. The largest spans hitherto adopted are 150 feet.

SURFACE TO CARRY THE TRAFFIC.

The roadway being so far constructed a layer of foundation stone 6 inches to 9 inches deep is laid by hand to a width of 14 or 15 feet; on this is spread a layer of 3 inches of broken metal, broken by hand, in cubes to pass through a ring of 2 inches diameter, however held, and the surface being finished with a very small quantity of clean gravel is consolidated, with iron rollers weighing 35 cwts., drawn by native bullocks, and a liberal application of water, a side drain about 2 feet wide and 18 inches deep is cut on the inside in side-long ground, or both sides in double cutting.

MATERIALS USED IN CONSTRUCTION.

Abundance of good stone exists almost everywhere in Ceylon; it is gneiss, a metamorphic rock, in a few places so clearly stratified as to render it easy to wedge it off from the quarry face in blocks suitable with but little dressing for the best masonry. The same stone, which is indeed the predominant geological feature of Ceylon, is used for the foundation and the metaling. Quartz gravel is common in certain parts of Ceylon, and where it is not found a fairly good hard gravel, known locally as cabook* gravel and abounding in clay iron stone, is found. This is in the formation known geologically as "laterite." Hardwood timber is scarce and difficult to obtain in the Central Province and other settled districts, and owing to the large consumption of fuel on tea estates is becoming more so every year; in the low country it is abundant.

Lime in the form of bowlders of almost pure carbonate of lime is found all over Ceylon, but the lime for mortar obtained from burning this stone is comparatively poor in quality as a building material. The best lime obtainable in Ceylon is made of coral, found everywhere along the seaboard, but rates of transport (Ceylon is not a horse or draft cattle breeding country) make its use in the interior expensive.

Portland cement imported from England is largely used for work exposed to wet and for concrete foundations, where such are necessary.

LABOR.

The labor employed on both the construction and maintenance of Ceylon roads is chiefly Tamil, originally from southern India. Though not physically equal to Europeans, Tamil coolies can do a good day's work and are housed and fed at a minimum of trouble and expense. Their pay ranges from 32† cents of a rupee to 42‡ cents for ordinary coolies, 50§ cents to a rupee for artificers, miners, builders, and carpenters, a rupee to two and a half rupees for highly trained artificers and foremen.

TOOLS.

The tools used in road construction and maintenance are much the same as are in use in Europe, but the spade and shovel are almost unknown, their place being taken by a tool called a mamoty, in shape like an adze,‖ but with a broad flat blade. Wheelbarrows are unknown, transport of material being chiefly performed by wicker-work baskets carried on the head, or by iron carts dragged by hand.

Trained elephants are used on road construction, especially in remote districts, where machinery and appliances for lifting or moving heavy weights are not to be had. The elephants drag stone on rough sledges formed of the fork of a small tree, to which they are attached with a rope collar and chain traces. They also can move enormous weights with their heads, and will exercise great care and intelligence when well directed in placing heavy stones in position on masonry works. Transport is also carried on with bullocks working in two-wheeled carts.

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* Laterite. † 12½ cents. ‡ 15 cents. § 18 cents. ‖ A clumsy hoe iron.

COST.

The average cost of first-class metaled and well-bridged roads in the hill country of Ceylon is 20,000 rupees* per mile; in the low country about 12,000 rupees.† Graveled roads cost about 5,000 rupees less per mile in each case.

The rupee, at the present value of silver, is worth about 1 shilling and 5 pence in English money; thus 2.83 rupees represents the value of an American dollar. The cost, therefore, of a first-class metaled road in the hills would be in American money about $7,067 per mile, and the cheapest road in the low country $2,473 per mile.

MAINTENANCE OF ROADS.

As before stated, the roads of Ceylon are maintained in a very efficient state; the surface and the drainage receive the most careful attention; a skilled European officer of public works is in charge of each departmental district, having about 100 miles of principal roads. He is under the direction of the chief engineer of the province and has under him a staff of native overseers and clerks. The system on which the roads are now maintained, known locally as "the MacBride system," was introduced in the year 1884 by the writer, the present director of public works (Mr. R. K. MacBride, C. M. G.), and was designed to introduce road reform, which was greatly needed in the colony, and to render dishonesty and peculation among the native overseers almost impossible. It has already saved the colony an expenditure of 3,500,000 rupees.

The amount of broken metal required annually to keep up the surface of the road and replace that worn away by the traffic has been learned by long experience with considerable accuracy. The work of the year commences by breaking this metal in the quarries adjoining the road, and either piling it continuously along the sides of the road to be repaired or in convenient depots at short distances apart. As a rule no metal is used until all is broken for the year, but a small reserve is always kept for the patching of ruts which May develop before the time for full repairs comes. The whole of the metal should be ready by May, when the southwest monsoon bursts and heavy rains may be expected. About this time the first annual clearing of surface and drains is undertaken. The scraping of grass or cutting away of jungle merely for appearance sake is strictly forbidden, but anything that impedes the free discharge of rainwater from the road is removed and the side drains are cleared of silt and vegetation. The edges of the road throughout its length are kept down below the level of the metaled surface, so that scupper drains, which are injurious, may be strictly prohibited. The metal being all broken and the rains having set in the repairs proceed at once.

If continuous ruts have developed, they are cut out to a width of 2 to 3 feet and a depth of a few inches; the old material so excavated is sifted and cleaned, the detritus due to the complete disintegration of the metal is thrown away, but the finer stone and unworn metal is retained as a blinding for the new material about to be laid. The rut is then carefully filled with new material, the blinding of old worn metal applied, and the consolidation by iron rollers of 35 cwts., drawn by one or more pairs of bullocks, proceeds. If the rains are not sufficiently lasting, water is collected in the side drains or led for long distances in the hill country and freely applied during the consolidating process. If the traffic has not developed continuous ruts the places that require repair are cut out in rectangular shapes and the process of repair is as above described. In some cases, and especially in towns, the whole surface is picked up annually and reformed and completed in a similar manner. A portion of the metal is reserved for a second repair later in the year when the second monsoon—that from the northeast—sets in, about October or November, when the rains receive their second clearing up.

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* Practically $8,000. † Practically $4,800.

Where this system is properly carried out the result is a road surface hard as adamant and smooth as a billiard table. The director of public works would be very glad, in the event of his visiting America, to afford the Department of State every information regarding the details of the road-maintenance system of Ceylon that bears his name. Tables are annexed showing the total number of miles of road open in Ceylon, metaled, graveled, and natural, the latter being merely tracks through the jungle, cleared of trees and roots but without culverts or bridges, and only passable for wheeled traffic in dry weather.

Diagrams are also appended showing the total expenditure on construction and upkeep for the past 6 years.

The average cost of maintenance per mile of all roads in charge of the public works department now is 314.80 rupees per mile per annum, or, in American money, $111.

The highest rate of expenditure on roads exposed to continuous and heavy traffic is 1,146.51 rupees per mile=$405. The lowest 170 rupees=$60.

R. K. MACBRIDE,
Director of Public Works.

COLOMBO, *Ceylon, July* 2, 1891.

Number of miles of road open in Ceylon.

Metaled roads	1,634.80
Graveled roads	965.44
Natural roads	541.90
Total	3,142.14

CHINA.

REPORT BY MINISTER DENBY.

Road making is an art, which, among the Chinese, has never been brought to any great perfection. It is remarkable that a people familiar, as they have been for centuries, with the essential part which roads play in commerce have never undertaken to improve the means of communication by land with their distant frontiers or between their great cities.

The explanation, probably, is that in the greater part of China proper there are water ways, natural and artificial, crossing the plains as a net, while human labor has always been found preferable to pack horses, or other beasts of burden, over narrow and circuitous mountain passes.

In southern China, at the centers of the tea trade, the long strings of coolies bearing down from the hills their fragrant burdens of tea leaves in deep baskets slung on poles is a familiar sight. The transport of brick-tea over the mountain roads of Szu-chuan into Thibet, a trade said to amount to £200,000 annually, is also effected by coolies, who here, on account of the steepness of the defiles, do not use carrying poles, but bear the tea on a wooden frame strapped to their shoulders. In this way they make a 15 days' journey over mountain paths of great difficulty, bearing about 100 pounds of tea each, for which service they receive the equivalent of from $3 to $4.

The importance of military roads has never been thoroughly impressed on the Chinese. The great campaigns of the Mongol and Manchu emperors were conducted with hordes of nomadio cavalry, whose movements were independent of fixed routes. It was the terrible Mongol horsemen who, in the thirteenth century, overran Asia, a resistless wave of barbarism, threatening even the kingdoms of Christendom. In the eighteenth century the Manchu conqueror's campaigns against the Mohammedans of Shi and Kashgaria were also conducted chiefly by mounted troops. In none of the wars of China has she yet faced the problem of the transportation of heavy ordnance.

In northern China, where water ways are not so numerous as in the south, intercommunication has always presented serious difficulties which no attempt has been made to overcome. Bridges have been built over some smaller streams, but are not kept in repair. The large rivers are to be crossed by ferries only, the smaller to be forded. At the ferries the ferry-boats are intentionally constructed with a high side-board so that the carts cannot be driven on without unhitching. This gives employment to acrowd of hangers-on, in unhitching and lifting on and off the carts, for a compensation. The other arrangements of the highways seem dictated by a similar motive. At some places there are bridges which are too narrow to be crossed by carts, where the mules are taken out and led over singly while the carts are carried over on men's shoulders. In time of flood there is frequently no way of crossing at all. Where nature has afforded no convenient impediment, bad characters sometimes dig holes in the road in order to obtain employment in helping carts through.

The roads themselves, outside the cities, are merely a line of ruts across the fields. In winter when free from rain, as they are for nine months in the year, they keep in very good condition. In summer they are a fathomless impassable bog, and travel except on foot is suspended. Inside the cities some of the most crowded thoroughfares are paved with massive blocks of stone. Where kept in repair these stone roads are serviceable, but they are so infrequent as only to accentuate the impassability of the others.

The importance of the rapid conveyance of intelligence to the center of government from the outside provinces has always been felt. In the days preceding the introduction of the telegraph this was accomplished by an elaborate system of post stations. These were placed some 30 miles apart and relays of horses constantly kept in readiness for the imperial courier. By these means dispatches have been sent to distant provincial capitals at the rate of 250 miles per day. This system was brought to great perfection under the Mongol emperors, if we may trust the description of Marco Polo. He states that Kublai Kahn had 300,000 horses, especially kept for the use of messengers, and more than 10,000 post stations. In connection with the mounted couriers an elaborate system of foot messengers was also maintained. The stations for the

runners were only 3 miles apart, and by them the Emperor is said to have received news from places 10 day's distant in 1 day and 1 night, or, if need be, news from 100 days off in 10 days and nights, "and that," to use Marco Polo's own words, "is no small matter."

Fruit gathered in Peking in the morning was thus transmitted to the summer palace, 10 days distant, arriving the evening of the next day.

A cruel custom prevails with reference to the official courier service in Thibet. The express courier from Gartok to Lhara, a distance of 800 miles, travels night and day. He is not relieved en route. His clothes are sealed onto him and can only be removed after the seal has been broken by the proper official. These messengers are lifted at the post stations from one horse to another and arrive at their destination with cracked faces and eyes bloodshot and sunken. They sometimes die on the way from exposure and fatigue.

The elaborate system of posts for imperial messages in China seems never to have suggested the establishment of a government postal service for the public at large. In spite of its autocratic and centralized character, the conveyance of the people's correspondence has never been considered a proper function of the government. All private correspondence is transmitted by private post-offices, or "hsin chii," of which there are several rival establishments in each city. These firms employ their own couriers, who travel by horseback or on foot or, where possible, by steamer. Speed is not a conspicuous feature of the system, though between cities where the business justifies a regular mounted service, letters and small parcels are carried at the rate of 75 or 80 miles a day. The charges for small distances are not excessive, a letter being sent from Peking to Tientsin for about 10 cents. For long distances, however, the charges are disproportionately large. This legation finds frequent occasion to use the private post for communicating with missionaries in the interior, particularly in Shantung. From Peking to Chinanfu, the capital of Shantung, is about 225 miles, and the usual charge for transmitting a letter thither is 40 cents.

One peculiarity about these postal establishments is their responsibility for loss or failure to deliver. Competition forces them to be thoroughly reliable and careful. At river ports at the hour of sailing of a steamer, the competition between rival firms in soliciting patronage through their runners is said to be a familiar incident.

That these systems of government and private posts should exist without leading to the construction of proper post roads and highways is remarkable. Over some mountain roads, however, which would otherwise be impassable, considerable work has been done and money expended. In some places the paths over the passes have been simply paved for foot travelers, but in others provision has been made for the passage of carts. Most of these roads date from great antiquity, but there are occasional instances of recent construction and repair.

The most important of recent improvements is the putting in order

of the road through the Chii Yung Kuan north of Peking. This is the pass leading into Mongolia from China, through the great wall, past the cities of Nankou and Kalgan. It is familiar to all tourists to Peking as the "Nankou Pass." The work of repair here was undertaken by the viceroy Li Kung-chang some years ago, and in the Peking Gazette of the 19th of May, appears a memorial from him announcing its completion. I inclose this memorial at length, to which I call attention, not only for its reference to the subject of this dispatch, but as illustrating a peculiar feature of Chinese government.

The system of intrusting important public works to the "gentry and literati" is not new in this country. Private subscription to public works such as road making, river embankment, public charities, etc., form an important resource of the treasury. The proposed plan of lending out the public funds to pawnbrokers is a thoroughly Chinese proceeding. The deriving of Government income from money loaned at interest to its subjects prevails extensively here, though the income is always, as in this instance, devoted to a particular purpose. Gentry who distinguish themselves by large subscriptions or by exertions in the public service are rewarded by tablets and arches or by the bestowal of honorary official titles.

The road whose completion the viceroy reports is said by recent travellers to be of the most creditable character. Drains have been made, substantial bridges built, inequalities leveled and obstructing rock hewn away. The new road will be of great benefit to local traffic but particularly for the transport of the immense quantities of tea shipped by Russian merchants, on camels, from Tungchou to Kiachta, via this pass.

CHARLES DENBY,
Minister.

UNITED STATES LEGATION,
Peking, June 7, 1891.

ROAD REPAIRING IN CHINA.

[Translated from the Peking Gazette of May 19, 1891, by Ch. Denby, jr., second secretary.]

Li Kung-chang, earl of the first rank, grand secretary, viceroy of Chihli, presents a memorial with reference to the completion of the work of repairing the road through the Chii Yung Kuan, the important thoroughfare north of Peking; he requests the gracious granting of rewards to those gentry who have exerted their efforts in the work. A respectful memorial on which the sacred glance is humbly entreated. Memorialist represents that Chii Yung Kuan in Yen Ching Chou is the first of the nine important places in Tai-Lsing. It is close to the capital. Such are its cliffs and abrupt hills that a step can scarcely be taken without danger. Former dynasties looked upon it as an important place for the protection of their frontiers. This dynasty, however, has borders widely extended. Those without and those within the pass are of one family. This road must be used by the princes of the inner and the outer Mongols bringing tribute in their journeys to and from Peking. It is used also for

the transport of military supplies for the forts on the frontiers of the two circuits of the northwest. This pass has not been repaired to any extent for more than two hundred and some score years. For 45 li the road pierces the hills and winds through gorges, where in summer and autumn water and stones dash downward, so that travelers go through with difficulty. In winter the streams in the gorges freeze to solid ice and many men and animals fall. The merchants regarded the road as a dangerous one. An urgent necessity existed to devise means for the repair of it for the public good. The amount of work to be done, however, was excessive and the funds required very large, and Chihli has long been a province deficient in revenue, whose public treasury could make no appropriation for this purpose.

In the fourth moon of the thirteenth year of Kuanghsii (1887), Chang Hung-chün formerly prefect of Hsüan Hua Fu, together with Chang Chéng-i, deputy magistrate of Yen Ching Chou, and Ho Chéng-hsii, district magistrate of the Huai-lai district, made inquiries as to the opinion of the elders and gentry and the views of the people in general, who all expressed themselves as of the opinion that a tax should be levied on cattle and beasts of burden passing to and fro to raise funds to put the road in order. In this arrangement the merchants at large rejoicingly acquiesced. It was accordingly decided to place a public office in the Chii Yung Kuan and levy from camels, mules, cattles, horses, donkeys, pigs, and sheep a charge of from 10 cast (2 cents) to 2 or 3 cast each, to be exacted of all alike whether coming into China or going outward.

Thus, from an expense inconsiderable to the merchants and people at large, was created a revenue to be relied on forever by the locality. The affair was easily started

Those who bring down government horses and return empty handed, women riding, unaccompanied by goods, and agricultural laborers gathering fuel and grass to be carried away on beasts of burden, are not required to pay anything, in order to show that proper discretion is exercised.

Li Hou-chi and other upright men from the literati of the locality have been selected and intrusted with the management of the work. They have agreed upon regulations which were submitted by petition to memorialist who authorized their provisional operation.

The magistrates of the several departments concerned repeatedly surveyed the said pass. From the eastern postal station at Chá-tao to Lang Chíao (Wolf Bridge) at Chang Ping Chou, it measures in all 6,730 chang (about 4,200 rods). The estimated quantity of earth and rock to be moved and the labor to be expended was very great. As the funds were to be derived from animals coming by at intervals, it was impossible to undertake the whole whole work at once. Hence the distance was divided into eleven sections to be put in order in succession. Work was begun at Pa-ta-ling and elsewhere which are the most dangerous localities.

At this time it happened that Hu Tung, a native of Yen Ching Chou, now an expectant taotai in Hupei, had returned to his native place and memorialist, inasmuch as he was thoroughly acquainted with the topography of the pass, ordered him to associate with the magistrates of the departments concerned in their consultations and undertakings.

At present, the road through the pass having been leveled by degrees, the number of carts passing through daily increases and memorialist, being petitioned, authorized the levy of a fee from them as from animals to be devoted likewise to the work of repair.

The officials and gentry concerned in the work made a thorough examination of the features of the locality and ascertained where dikes must be built, drains dug, holes filled, elevations leveled, and where land should be bought from the people to make a detour, and where the road should be carried along a hillside to make a thoroughfare. The road has been made 45 chang (450 feet) to 1 chang (10 feet) or 2 chang (20 feet) broad, differing in different places. The sections of the road have

been successively repaired, diked, and leveled so that carts even now traverse it without danger or obstruction.

If it is intended that the work shall endure it can not be completed in one day. Whenever a heavy rain falls the water rushes down from the peaks with myriads of stones, as if heaven were being dragged down and earth uplifted. If these stones become jammed together the road overflows to great depth and there is no thoroughfare through the gorges. The causes of these defects must be ascertained and remedies sought therefor that control may be established.

During the summer of last year there suddenly came on a continuous rain which lasted many days and was heavier than for scores of years. The part of the road first repaired, that at Pa-ta-ling, which was called the Tien Ksien, though it encountered this terrible flood still remained unhurt. Other places were slightly damaged, but were easily repaired. At Tan Chin Gorge and at the Buddha's Stone Shrine the hills on both sides crowd together and leave no space to carry off the water. Here the abutments of the road were half washed away. Man's strength is inadequate, in view of the circumstances, to avoid such mishaps. It was therefore decided to change the road to the west side and make a circuit around these two places. The main road will be reëntered again at Lin Lang Ting. By avoiding watery places and following mountain paths, by making earth roads and keeping out of the way of rocks, it is hoped that future damage will be escaped. This suggestion being made by those in charge of the work they were ordered to take action accordingly, and, on the 18th day of the second moon of this year, they reported the completion of the work.

Orders were given to send Wang Shou-cheng, prefect of Hsüan Hua to inspect the part of the road which has been leveled, and it is found that merchants going north and south have been greatly benefited. There is, however, no work which will not deteriorate with lapse of time. The road through the pass will be trampled and worn by horses and carts and eroded by wind and rain. Unless means are devised to provide funds for the important repairs it is to be feared that after some years the labor and hardship which have been spent upon this work will be found to have been in vain.

The total receipts from animals from the middle of 1887 to the beginning of 1891, have been 29,160 strings of cash (about $25,000). The merchants of the vicinity subscribed also 600 taels of silver. Over and above what has been expended there remain only 3,500 strings of cast and 600 taels. This sum is insufficient. The tax on animals must be retained for several years, not only to defray the incidental repairs, but to collect the sum of 10,000 taels, upon which the toll will cease. The income from the cart tax commenced after the beginning of the work on the road, and when the tax on animals is abolished the tax on large carts must be retained several years. This also will stop when 5,000 taels have been raised. The two above sums will be kept apart and loaned to merchants to produce interest. The interest from the tax on animals will be used only for annual repairs; that from the sum collected on carts for the expenses of great repairs. Regulations will be enacted establishing a mutual supervision between gentry and officials to prevent unlawful usurpation, waste, deficit and misappropriation.

Progress will hereafter be made in the art of road repairing, and every day the road will improve so that for scores of years it will cause no anxiety. All rejoice that a dangerous way has been made smooth.

The gentry engaged in the affair have relied upon their own resources in effecting the repairs, having made no perquisites whatever. Through 5 years they struggled against hardships diligently, accomplishing a difficult task. Now it has been brought about that a pass, in which a horse could scarcely place a foot, has been transformed into a level road, over which loaded carts easily travel. This manifests the credit of those intrusted with the work. They are really deserving of praise, and it is proper to recommend the more meritorious for reward.

AMOY.*

REPORT BY EDWARD BEDLOE.

INTRODUCTORY AND EXPLANATORY.

Road making as an art involves at least five factors: First, the nature of the materials employed or local lithology; second, the topography of the country traversed; third, the geology of the country traversed; fourth, the climatology of the country traversed; and fifth, the system employed by the roadmakers.

All of these vary from point to point, so that in no two places do the same conditions prevail. It is well to bear this fact in mind, as one accustomed to a kind of work perfectly suited to the locality to which he belongs is very apt to misjudge work perfectly suited to another locality with whose circumstances he is unfamiliar. The roads of Amoy are very different in many respects from those which prevail over the larger part of the United States, but they are admirably adapted to the conditions imposed by the five factors enumerated. To understand the first thoroughly it is necessary to understand the last.

On account of the facts hereinafter set forth there is no difference between city streets and country roads in Amoy. All are made of the same materials, in the same way, and under the same law. If streets are to be taken as those complex institutions, so familiar to Americans, which serve as thoroughfares, water conduits, sewer, water, gas, and electrical ways, there are none such in Amoy. There is no difference between the most crowded city district and the lonely cemetery in this particular regard, exc epting that the roads are less worn in the latter than the former neighborhood.

LITHOLOGY OF AMOY.

The only rock formation in Kulangsu and the chief one in Amoy is granite. Where it has not been acted upon by the elements, *it* is a hard, handsome stone resembling Quincy granite, but neither so strong nor so durable. It is seldom quarried on Kulangsu, what cut stone is used there being brought from other parts of Amoy.

The elements act upon the granite in different ways. The commonest is where the rock has been corroded until it has become a nodular hardpan. This represents two-thirds of the surface of Amoy. It is too tough to be taken up with the spade or shovel, but offers practically no resistance to the pick or crowbar. In this condition, as in fact in all others, where it has been greatly weathered, it is very porous, as is shown at every rainfall when the water instead of collecting on the surface, percolates downward many feet, if not yards. It has little filter-

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* Consul Bedloe acknowledges his obligations to the following gentlemen for assistance rendered in the preparation of this report: Francis Cass, William S. Fales, H. E. Howard, K. Ping, and John H. Coombs.

ing power, less than sand, and much less than sandstone or magnesium limestone.

At the United States consulate, a large amount of slaked lime was used as a fertilizer upon the garden and grounds. The rain took up considerable quantities of lime in both solution and suspension and carried these downward at least 80 feet below the surface into the well on the premises. The water of that well has been calciferous ever since.

At Dakin's pharmacy the well, though thoroughly cemented, shows the permeability of the decayed granite in which it is sunk by a very percepti ble osmosis of salt water from the bay whenever the dry season sets in and the water in the well sinks below the level of the sea.

The well at the London missionary establishment shows traces of drainage from the Chinese quarter in that neighborhood.

A well near the go-down of F. C. Brown & Co. shows that it receives an appreciable amount of petroleum compounds and lixiviation products from the go-downs and thoroughfares of that vicinity.

The water of the well below the cemetery at Lam-paw-do contains lime from the white wash of the numberless graves there, and probably small quantities of organic matter from the interred bodies.

The third stage of the decomposition of granite is marked by a coarse gritty sand and by beds of clay. Of the former there is any amount, and of the latter large quanties in the bed of the harbor. Anyone who will take the trouble to examine the land between high and low water mark will find it clearly divided into two belts. The upper, or one nearer the shore, is granite sand, and the lower clayey mud. By digging through the former clay will be found at every point. The fact is utilized at Chich-Boe where the Chinese use this clay to make fine tiles and terra cotta.

The three stages described are general; between them are any number of intermediate ones. In fact as an entire series from the virginal rock, at one extreme, to the coarse sand and clay at the other may be found at many places in Amoy.

There is no limestone in the immediate vicinity of Amoy. The lime used in the various industries is made by burning oyster, clam, and other molluscan shells, or else imported from other districts.

Cement rock does not occur in Fuh-Kien so far as is known. What is consumed is imported. Formerly nearly, if not quite all came from Europe. In the past 20 years inexhaustible supplies of first-class quality have been found in the British, Dutch, and Spanish East Indies, and these now control the market.

Besides the granite sand described, there is a fair grade of ordinary sand along the beach, made out of the former by the triturating action of the waves.

There is little or no gravel, shingle, or shards.

Of the artificial stones, those made from clay largely preponderate. These are used in road making, as are also fragments of crockery, earthenware, mortar, cement, and shells.

TOPOGRAPHY.

The surface of Amoy, its adjacent islands, and the surrounding country is very rocky and uneven. Summed up in a few words, it consists of ranges of granite hills and mountains varying from 1,000 to 1,800 feet in height, with the intervening space filled in with subhills, huge bowlders, and small alluvial plains. A rough estimate would divide the surface of the territory as follows:

	Per cent.
Mountains whose slope is more than 45°	20
Mountains whose slope is less than 45°	15
Hills	30
Bowlders	5
Plains	30

The mountain ranges are continuous, with irregular outlines rather than saw-like, as with the Sierra Nevada of the North American continent. They are dotted and at places half covered with bowlders.

The roads follow the plains as far as possible, skirt the sides of the hills and mountains, and in many cases go over the hills instead of making a detour around them. This occasionally necessitates very sharp gradients and renders the use of carts, wagons, and carriages impracticable if not impossible. Even the employment of rickshows (jin-rik-i-shas) is attended with danger.

The tides are very high (21 feet 6 inches in the spring), so much so that although there is a very wide beach between low and high water mark it can not be used for travel. At high water the sea reaches the hillside, and at low water the beach is too soft and oozy for either pedestrian or equestrian purposes.

GEOLOGY.

The island of Amoy and its neighbors, including Kulangsu and Little Quemoy, are portions of a rocky and uneven territory, containing few small plane surfaces, which, prior to the glacial epoch must have extended from the foot walls of the mountain range (of which Lam-tai-bu, 1,180 feet altitude, is the leading peak) to Quemoy, and probably reached further out into the Formosa channel.

The islets of Wu-seu and Quemoy-spit are undoubted relics of what was once a much larger expanse of land.

Prior to the glacial period the country must have been more fertile than it is to-day, owing to the possession of a larger amount of superjacent soil. Much of it was like the arable belt along the southwest edge of Kulangsu. It supported a large vegetable life, as is evidenced by traces of lignite and carbonaceous soil at every point where the mountain slopes have prevented the erosion of the soil by the movement of the glaciers in the far past.

Several excavations made for funeral and architectural purposes have encountered thin beds of carbonaceous soil beneath the hard pan which constitutes so large a portion of the present surface.

The fauna of that period were apparently more numerous than those of to-day, and included deer, goats, pigs, buffaloes, tigers, leopards, monkeys, cave-tigers, cave-bears, cave-wolves, jackals, wolves, and bears. There seem to have been alligators, boa constrictors, and elephants, but this is not yet certain.

There are evidences of prehistoric man in shell mounds, and in ashes and bones, in caverns, and also in implements of stone.

The glacial epoch must have been of short duration, as there is an absence of sand, shingle, and gravel, very remarkable. There is of course a very large moraine beneath the Formosa channel, and small ones near Chiang-Chiu, Chloh-Jim, Lian-Ho, and other points. On the other hand there was a large transportation of bowlders by the glaciers from Peh-phang-nia-teng, Him-sek-poa, and the mountainous districts of the north and northwest, and their deposition at every point between the mountains mentioned and the low-water mark beyond. The great blocks of stone are found on every mountain and below the surface of the water to a depth of at least 10 fathoms.

Of the bowlders scattered over Kulangsu the majority are a granite, resembling syenite, but numbers consists of gneissic granite, diorite, delorite, graphic granite, auriferous quartz, and sometimes, though rarely, of semi-micaceous schist, carboniferous limestone and sandstone.

The auriferous quartz indicates the presence of gold not more than 150 miles from Amoy, and the carboniferous rocks of coal measures much nearer the coast.

The lithologic variety shows that glaciers which found their embouchement about Amoy must have reached at least 100 miles from the coast up into the interior of Fuh-Kien. The height of these glaciers, or this glacier, for in all probability the land was covered by one unbroken sheet of ice for leagues and leagues, is hard to determine.

Glacial scratchings are found at every point on Kulangsu and Amoy and even on the summit of Lam-tai-bu. The glacier therefore which once covered the district must have been over 1,180 feet thick. If we are to judge by analogy and use Lyell's researches in Great Britain and Tyndall's in the Alps as our guide in estimating its dimensions the Amoy glacier was from half a mile to 1 mile thick, and in its full career covered the Formosa Channel and all of the Island of Formosa excepting a few high peaks. It reached far out into the Pacific Ocean, extending in every probability beyond the axis of the Botel-Tobago Archipelago.

The paucity of moraines and the wealth of bowlders indicate that the glacial epoch terminated very suddenly so far as Amoy is concerned. A glacier dies from one of two causes; either there is an increase of temperature too great for the continued existence of ice or there is a large decrease in the supply of the water which in congealed form goes to make it up. Sometimes the two causes combine and make one. When the decrease of a glacier is slow there is a large deposition of

gravel, sand, and earth along with bowlders. When it is rapid there are bowlders and comparatively little gravel, sand, or earth. As there are little soil, few moraines, and many bowlders on Kulangsu and Amoy it is probable that both causes mentioned united in this instance and that the great glacier retreated suddenly and rapidly from its maximum development back to the mountain chains in the interior of Fuh-Kien. No other hypothesis can be framed which will satisfactorily explain the present topographic and lithologic condition of the neighborhood and its surrounding territory.

The rocks mentioned indicate that there has never been any volcano nor volcanic action in the immediate neighborhood of Amoy. A few diorite bowlders with lava-filled veins prove that to the north or northwest there is a district which at one time was the scene of tremendous volcanic activity.

The absence of seams, faults, or crevasses is evidence that there have never been any serious earthquakes in Amoy, except it may be the dying tremor of some seismic convulsion many miles away. We are also led to the inference that there never will be a volcano or an earthquake near Amoy so long as the present coast line remains unchanged in its general features.

This theoretic view is confirmed by the fact that all the Chinese accounts and traditions of earthquakes locate them in the far south towards the Malay peninsula, the far west in the district of Sz-Chuen, or the territory bordering on the mountains of Quin-Lun and the extreme northeast, where, at some period not very distant, there was considerable volcanic and seismic action.

The absence of all stratification, the weathering of the granite, and the non-existence of fossils, Tertiary or Post-tertiary, in or upon the rocks above a plane 10 feet above spring high-water mark show that this part of the coast of China has been exempt from the processes of submergence and upheaval which have been so common in the geologic history of other lands. As Kulangsu looks to day it looked many thousand years ago, except that it was greener and prettier then and a trifle more pic uresque. It was the same, but more rocky, ragged, and forbidding when neither the Alps, Apennines, Himalayas, Rockies or Andes had been born. It is as old as the Apalachian range of North America and the Norwegian headlands, the two oldest monuments of the slow development of the great globe we live upon.

The weathering of the granite of Amoy is something phenomenal. At points the solid rock has been disintegrated 50 and 60 feet vertically. The breaking down has been confined to the feldspar, although both the mica and hornblende have been affected. Of the different kinds of feldspar the orthoclase shows the greatest decay, with the heteroclase a close second. Near the sea this disintegration has been of no benefit to human or vegetable life. The potash, soda, and lime salts, the clay and other valuable products of the decomposition of granite have run into the sea and been lost. In the interior country the alka-

line salts named have been absorbed by the soil and are valued fertilizers. The clay accumulates, forms beds, and is in the after years utilized for bricks, tiles, chinaware, and terra cotta. The chief advantages of disintegrated granite are that it makes good roads or country pathways and excellent walks or paths in the garden. Mixed with lime it makes a good mortar, and with cement a very good concrete.

CLIMATE.

Amoy lies in 24° 40′ north latitude and is just outside of the tropics. It has practically but two seasons, the wet and dry. The former begins in February and closes in June and is about 4 months long; the latter constitutes the remainder of the year.

The annual rainfall is about 46 inches, which fall in 445 hours in 100 days. It descends in large quantities in a short time, and owing to the topography exerts a powerful erosive action, producing gulleys in the thoroughfares and deep channels at the foothills.

The temperature varies from a maximum of 95° F. in July to a minimum of 40° in March. Its annual mean is 70°.7 F., making the isotherm of Amoy the same as that of the Pacific coast of the lower part of California.

The barometer is subject to great fluctuations, especially during typhoons. Its annual mean is 30.095, almost the isobare of Mobile, Ala., and Jacksonville, Fla.

The hygrometer varies from 95 maximum to 10 minimum and has an annual mean of 28, making it a very dry climate.

The atmosphere of Amoy is seldom without good winds. The northeast monsoon blows almost continuously at the average rate of 10 miles per hour from September to April, and the southwest monsoon at the average rate of 8 miles per hour from April to September.

Besides these there is a local west wind from the mountains from about 4 a. m. to noon, attaining a maximum at 9 a. m., and a local east wind from the ocean from about 4 p. m. to 10 p. m., attaining a maximum at about 7:30 p. m.

A meteorological abstract for the year 1890 is as follows:

	Barometer.				Thermometer.			
	Maximum.	Minimum.	Mean maximum.	Mean minimum.	Maximum.	Minimum.	Mean maximum.	Mean minimum.
	Inches.	*Inches.*	*Inches.*		*Inches.*	*Inches.*	*Inches.*	
January	30.35	30.02	30.40	30.25	70	48	62	54
February	30.36	29.80	30.34	30.17	75	51	64	57
March	30.60	30.01	30.31	30.16	75	48	60	55
April	30.26	30.01	30.18	30.06	82	55	71	65
May	30.18	29.86	30.08	30.00	82	66	77	71
June	30.16	29.90	30.04	29.94	87	70	82	78
July	30.10	29.58	29.92	29.82	94	76	86	81
August	30.08	29.75	29.97	29.74	89	77	86	80
September	30.10	29.76	30.02	29.94	90	73	85	78
October	29.85	30.29	30.01	29 96	89	80	80	65
November	30.41	30.09	30.32	30.20	75	66	74	58
December	30.43	30.02	30.28	30.17	73	51	68	61

	Solar radiation.			Weather.			
	Maximum.	Minimum.	Mean.	Days rainy.	Hours of rain.	Rain in inches.	Days foggy.
January	132	65	110	9	74½	2.01	1
February	152	76	120	7	14¾	1.14	5
March	141	57	100	20	103¼	9.25	3
April	148	69	125	4	27	1.23	11
May	154	92	131	11	56½	3.27	2
June	154	91	136	17	78¼	9.83	.....
July	156	130	149	10	23	7.90	.....
August	157	141	150	12	13⅓	4.03	.....
September	155	92	144	8	14½	0.66	.....
October	148	126	137	.....	.....	.....	.....
November	133	113	132	.....	3¾	4.27	.....
December	156	65	110	1½	36	2.01	.....
Total	.....	.....	.....	99½	444¾	45.60	22

ROAD MAKING.

The roads in and around Amoy are admirable and are kept it splendid condition; when the ground is hilly, they are cut from the hillside; when the ground is level they are built up.

They vary from 20 to 30 feet in width and rise in the center about a foot above the level of the edges. Where the ground slopes, the rise increases in proportion in order to prevent the rains washing away the center of the roadway and the edges are guttered or ditched.

The main road of Amoy is 30 miles and the smaller roads and streets aggregate 150 miles in length.

In making roads on level surfaces a foundation of broken granite is loosely laid with a gentle slope upward toward the center; on this is laid smaller pieces of granite, broken brick and earthenware, and sometimes shells; on this in turn is put a mixture of granite-sand, clay, and lime. The road is sometimes rolled, but usually is battered down with hammers. The top mixture is applied wet and sets in 24 hours. Its composition varies as will be seen by the following instances:

No.	Sand.	Clay.	Lime.
1	5	5	1
2	10	3	1
3	4	2	1
4	10	4	1
5	5	4	2

In making it the sand, lime, and a little clay are mixed with water in a brown mortar and applied to the road; after the application and before it sets the remaining clay is thrown upon the surface and hammered down. There seems no particular rule as to the amount of top mixture to the square of road. It runs as low as 75 catties and as high as 175 to the square yard (100 pounds to 233 pounds).

The second layer runs from 1 to 4 inches in thickness, and the lowest from 6 inches to a foot.

The prices per diem paid for labor, etc., are as follows:

Quarry men	$0.25
Stone-breakers	.15
Stone-helpers	.10
Diggers	.20
Carriers (who carry 75 pounds to a load)	.20
Rammers	.20
Foremen	.30

The crude stone costs nothing, as farmers and others are only too glad to have the rocks and bowlders taken away from their land. Clay costs nothing when it is taken from the common land; when bought from private parties it costs from 1 to 5 cents a picul (135 pounds).

Common lime (the cheapest and most impure is used for the purpose) commands anywhere from 3 to 25 cents a picul.

The amount of labor performed by a Chinese coolie is much less than that by a Caucasion, and is seldom more than one-half. He never gets drunk, never strikes, and works on Sunday as on week days.

The cost of making a road is about $1 (Mexican), or 77 cents (American) per square yard.

The Chinese law requires roads to be kept in good order. The responsibility is put upon the headman of a village, the owners of the adjacent property, and the shopkeepers whose premises abut upon the thoroughfares.

In conclusion, it may be stated that the roads and wacks of Amoy are excellent and on a par with the best in the United States.

EDWARD BEDLOE,
Consul.

UNITED STATES CONSULATE,
Amoy, March 16, 1891.

FOOCHOW.

REPORT BY CONSUL GRACEY.

There are no roads in this part of China. The streets of Foochow are from 6 to 12 feet wide, many of them covered with stone slabs which are filthy beyond description, and are perfectly execrable.

We have no wheeled vehicles, and, as a consequence merely foot-paths all through the country.

SAMUEL L. GRACEY,
Consul.

UNITED STATES CONSULATE.
Foochow, January 17, 1891.

HONGKONG.

REPORT BY CONSUL SIMONS.

In reply to your circular of November 8, 1890, I have instituted inquiries concerning street and roadway construction in Hongkong with the result given below in a letter from the surveyor-general.

In reply to inquiries contained in your letter of the 12th instant I have the honor to give below a description and cost of the principal forms of road construction adopted in the city of Victoria. As there is comparatively little carriage traffic, and the main wear and tear are caused by the numerous jinrickshas, we are able to adopt a much lighter form of construction than would be required if we had to provide for the yassage of heavy vehicles.

1. Macadamized roadway, formed of 3 inches in thickness of granite, broken to 2½-inch cubes, with a top dressing of granite broken to 1-inch cubes, blinding of decomposed granite, costs per superficial yard 18 cents.

2. Concrete roadway formed of a layer of concrete 4 inches thick, composed as follows: 9 parts of granite broken to 1-inch cubes, 3 parts shell lime and 2 parts red earth, costs 32 cents per superficial yard.

The macadam is adopted generally on the level roads and those of moderate gradients.

The concreted roadway is found well suited to the very steep roads running at right angles to the sea up the hillsides in the direction of the peak.

So far as technical knowledge of the subject is concerned I can add nothing to the foregoing. Notwithstanding the light character of the traffic over streets and roads so constructed they require considerable repairs, particularly during wet weather when the ground beneath softened by water no longer affords a firm support to the macadam which sinks in places forming depressions, these rapidly becoming ruts unless repaired.

The "heaving" effect of frost would, I believe, prove disastrous to streets so constructed while a loaded track would crush through the crust once the ground underneath become saturated with water. The streets and roads are considerably higher in the center than the gutters, which are made of cut stone.

With few exceptions no sidewalks are provided, pedestrians taking the middle of the street. Both streets and roads are kept in good repair and always scrupulously clean—one of the first things to attract the attention of visitors to Hong Kong.

O. H. SIMONS,
Consul.

UNITED STATES CONSULATE,
Hong Kong, January 20, 1891.

NINGPO.

STREETS.

The streets in the cities of this district, like those in all the rest of China, are poorly laid out, rarely exceeding 10 or 12 feet in width; they

are most generally paved with large slabs of granite, about 2 feet wide by 3 feet long and 4 inches thick; under these are sometimes drains. It is a difficult matter for a stranger to walk on these stones on a rainy day, as the constant friction from the straw and wooden shoes of the natives has made them very slippery, while not wearing them smooth. The streets are kept in repair by the subscriptions of the gentry. It would be next to impossible for a handcart to pass through these cities, on account of the narrowness and crookedness of the streets.

COUNTRY ROADS.

The roads in the country are mere paths, averaging 4 feet wide, and are sometimes paved with round stones, at other times with slabs, by simply laying them on the top of the earth; at intervals a shed is built over the path, wherein a traveler can rest sheltered from the rays of the sun. These are called "rest houses." Now and then a square stone about 4 feet high and perhaps a foot square is seen close to the road; the traveler weary with his load places his back to this stone and lets his load down onto this stone and rests awhile, and when he is ready to renew his journey he does not have to pick up his load from the ground, but simply from this resting post. All roads, country and city, are built and kept in repair by subscription. There are no laws or regulations relating to roads, and the Government does not give a dollar towards their maintenance. There is not a wheeled vehicle of any kind in this vast district of nearly 40,000 square miles; everything is either carried on the backs of men or in boats through the canals. The roads in this district are the canals, which intersect every quarter, and one can travel in almost every direction for hundreds of miles by these canals.

JOHN FOWLER,
Consul.

UNITED STATES CONSULATE,
Ningpo, February 3, 1891.

SHANGHAI.

REPORT BY CONSUL-GENERAL LEONARD.

There are none but the most primitive and unimproved roads and streets in China, except in the few foreign settlements at the treaty ports, and there they are generally excellent, being constructed the same as in England.

Nearly all the travel and traffic of China is carried on by the rivers, and the canals, which have been built only a few miles apart all over the settled portions of the country.

The roads are but little used by travelers and wheeled vehicles as lit-

tle as possible, most of the land travel being in chairs carried by coolies, or wheelbarrows, which are used both for goods and passengers.

J. A. LEONARD,
Consul-General.

UNITED STATES CONSULATE-GENERAL,
Shanghai, January 12, 1891.

JAPAN.

REPORT BY VICE-CONSUL-GENERAL SCIDMORE, OF KANAGAWA.

The subject of scientific road building in Japan is a matter that has only of recent years received attention.

Previous to the opening of the country to foreign intercourse nearly all of the inland travel and carrying was confined to the backs of coolies and pack horses, and in spite of the introduction of railways and jinrikishas such is, to a very great extent, still the case.

Macadamizing is followed in the streets of the larger cities, but the work is generally of inferior quality.

In the country some of the main roads are fairly well kept, but the general rule is to repair the highways with loose earth, which naturally renders them execrable in bad weather.

The maintenance of these roads is at the cost of the local village or district authorities from taxes levied specially for the purpose.

G. W. SCIDMORE,
Vice-Consul-General.

UNITED STATES CONSULATE-GENERAL,
Kanagawa, Japan, January 28, 1891.

PHILIPPINE ISLANDS.

REPORT BY CONSUL WEBB, OF MANILA.

INTRODUCTORY REMARKS.

There is little or nothing to be said of the streets and roadways of the Philippine Islands that can possibly be of any practical value to the people of the United States, except in so far as it may serve as an illustration of the sad and demoralizing effects of neglect and indifference. It has been said that the cities and towns of this archipelago are at least a hundred years behind the rear guard in the procession of progress, and one who travels over the streets and roads of the country can hardly fail to become impressed with the truth of the assertion. There is apparently no incentive to improvement and no disposition to do anything more for the country than is absolutely

necessary for the comfort and convenience of the foreign residents who very rarely expect to remain here longer than 5 years. Probably it is this transient, ever-changing character of the foreign colony that may be taken to account for the fact that there is not a single driveway beyond the city limits of Manila, Iloilo, or Cebu, nor a roadway which will allow the passage of a four-wheeled vehicle with any degree of comfort to its passengers or of safety to its integrity. The Spanish officials who come here rarely, if ever, remain longer than 3 years, and the average term of service of the English and German merchant and clerk is 5 years; therefore the material development and permanent improvement of the country is left to the natives, who fail to appreciate the necessity of improved streets and roadways, and to the mestizos who do not feel disposed to develop the islands, knowing, as they do, that an advance in this regard must necessarily be followed by an increase of the already excessively burdensome taxes.

THE CITY STREETS.

The principal cities of the archipelago are Manila, Iloilo, and Cebu, and these are the only ones that have any of their streets paved. The principal business streets are paved with limestone blocks imported from China and laid upon a bed of gravel and sand. In Manila there is less than 2 miles of this pavement all told, and in Iloilo and Cebu possibly half that amount. All the other streets are macadam with a top dressing of sand and gravel, and ordinary dirt roads kept in comparatively good condition by throwing upon them dredgings from the ditches on either side.

The government assumes the responsibility of keeping the streets and roads in repair and fulfills the obligation by working upon them certain of the city prisoners who have been sentenced for slight offenses, such as failure to procure a "cedula personal," or identification card, or to have neglected to comply with some other civil regulation. The duty of street inspection and of making minor repairs is left with the native "bomberos," or firemen, but the wretched condition of most of the streets outside the business quarters indicates that they are not over zealous but are disposed to do barely more than enough to avoid censure from their superiors. There are half a dozen streets that are used by the foreign residents for evening drives, and these are kept in reasonably good condition through the efforts of the Spanish officials. They are made with a foundation of broken rock, over which gravel and sand from the river and estuaries are thrown. Buffalo carts are almost constantly in use for the purpose of hauling gravel and sand to these streets, and the unremitting repairs keep them in a state that admits of fast driving and comfortable riding.

There are no heavy drays in use, the heaviest vehicles being the two-wheeled buffalo carts and the pleasure carriages, which are mainly light victorias, broughams, and barouches.

Outside of the business centers and the districts occupied by foreign residents the streets are generally poorly kept dirt roads flanked by muddy ditches which, during the major portion of the year, are filled with stagnant, slime-covered water, which in any other country would be considered as extremely dangerous to the public health.

COUNTRY ROADS OR HIGHWAYS.

The great majority of the country roads are almost impassable during the rainy season, and are only traversed during the dry months by the light two-wheeled "carronatas" of the country, which are generally drawn by two horses. They are made by throwing up the dirt from the ditches along their sides, and in many places are so rough and uneven that riding in the carronatas is anything but comfortable. The passenger is jolted about in a most disagreeable manner and usually arrives at his journey's end with every muscle in his body bruised and aching as if he had been rolled down a rocky mountain side. In some cases he is obliged to leave the vehicle and walk half a mile or more while the horses struggle along with it through the sink holes and over the rocks and hummocks. At many points the road is merely a track worn by the carronatas over a level plain with no ditches at its sides and without evidence of repairs of any kind. No attempt is ever made to haul the produce of the provinces over these wretched roads and all that reaches the cities comes by water in barges and sloops.

The authorities of the various towns and villages are supposed to look after the repairing of the roads, but the condition of the latter is striking evidence of the indifference and neglect manifested in everything in the way of public improvements. In many of the provinces there is but one of these dirt roads, the main one used by travelers from town to town, but the country is traversed by numerous footpaths, over which the natives carry produce on their shoulders or heads. The major portion of the archipelago is practically an undeveloped wilderness.

ALEX. R. WEBB,
Consul.

UNITED STATES CONSULATE,
Manila, Philippine Islands, January 8, 1891.

TURKEY IN ASIA.

PALESTINE.

REPORT BY CONSUL GILLMAN, OF JERUSALEM.

STREETS.

The principal pavements made in Palestine are in the city of Jerusalem, and it is only within recent years that they have been constructed in accordance with anything like modern requirements. The superior and massive Roman pavements, over 2,000 years old, and still in fair preservation, are not here taken into consideration. They are, indeed, hidden from sight and use many feet beneath the rubbish of the city.

The material used for streets is stone cut to about the shape and size of ordinary brick, or a little larger; this is laid in sand, the long and narrow side up. No teaming is allowed over such a street. In the few streets where carriages are permitted to pass the center of the street is macadamized, only the sides being paved.

The stone used is generally the harder kind of the so-called Jerusalem marble, which is really only a species of limestone partially turned to marble. Of this there is a great variety, differing much in quality.

For the fully paved street the cost varies from $1 to $2 per square yard. The depth of the pavement rarely exceeds 6 inches. The foundation is almost invariably the rubbish of the ancient city, which has accumulated during centuries, and through its frequent destruction in sieges, etc.

Where streets are paved in Jerusalem at the present time, well-constructed stone sewers are always made beneath them. These are at various depths, according to the requirements of the case.

Many of the streets ascend steep hillsides. These are built in terraces, with steps; the rise of the steps or terrace being protected by a broad flagstone, set on end, at the level of the pavements. Of course, in such cases, teaming is out of the question, and they generally wear well.

HIGHWAYS.

The roadways built within late years in Palestine, and those in process of construction, are greatly superior to those formerly made under the Ottoman Government. At present they resemble good macadamized highways, properly graded, and in many cases provided with side drains. Where necessary, in crossing the more dangerous passes, stone parapets of mason work are built along the precipices. The material used for the roadbed is the ordinary limestone of the country, broken up into the usual cubes of the required size. This is covered with earth or gravel, which is finally leveled and smoothed by heavy stone rollers. The foundation varies, being commonly the stiff clay of

the country, though sometimes it is of sand or rock. Where the grade has to be considerably raised, large bowlders are rolled into place to form the foundation of the roadbed. The cost of such a road is from 80 cents to $1.30 per square yard.

REMARKS.

The methods and peculiar system followed here are not favorable to the best work, and can not be taken as a criterion for more civilized countries. A large part of the work is done through the enforced labor of the peasantry, which nominally costs nothing, and the materials lie adjacent to the roadway in unlimited abundance. The chief expenditure is for the superintendents, engineers, and overseers, of whom there is always a superabundance, ludicrously out of proportion to the requirements of the case.

As to the maintenance of streets and roadways, this is but seldom attended to in this country. Where a good road is made it soon falls into disrepair, through its being almost totally neglected.

The effect of improved roads upon land values and other economic conditions is as not as pronounced as it is in other lands. The camel is here the chief agent for transporting merchandise, and is largely used in all traffic. This does not necessitate a finished road. The introduction of carriages and wagons is comparatively a recent innovation, caused by the large influx of travelers and the establishment of foreign colonies.

HENRY GILLMAN,
Consul.

UNITED STATES CONSULATE.
Jerusalem, January 28, 1891.

SYRIA.

REPORT BY CONSUL BISSINGER, BEIRUT.

THE BEIRUT-DAMASCUS HIGHWAY.

It would hardly, perhaps, be expected that a report on "country roads or highways" in this far-off eastern country could be of any possible value, and yet Syria maintains at least one highway that will compare very favorably with any road in America or Europe, and a description of the same may therefore not be wholly without interest and perhaps even of some slight practical value. It is the carriage road from Beirut, on the Mediterranean, to Damascus, on the other side of the Lebanon Mountains, a distance of 113 kilometres or about 70⅝ miles, completed 1860.

CONSTRUCTION OF THE ROAD, ETC.

According to the statement of the officers of the company—for the highway is owned and operated by a private stock concern—the roadbed is made of a layer of macadam 20 centimetres in thickness, reposing upon a substructure of ordinary earthwork

This "macadam" is composed of a compact mass of calcareous pebbles of not more than 6 centimetres in diameter, spread over the substructure of earthwork in such a manner as to have gentle slope from the center of, say, 1:30; heavy metal rollers of about 5 metric tons, drawn by twelve mules, pass over and crush the pebbles, this making a smooth and even roadbed.

The cost of the material for metaling or ballasting is 1 franc 60 centimes (32 cents) the cubic metre, crushed, sifted, and measured, exclusive, however, of the cost of transportation, which is about 40 centimes (8 cents) the cubic metre.

Along that part of the road which passes over Mount Lebanon this material is extracted from quarries in close proximity to the road itself, and the cost of transportation is therefore insignificant; but in the plains and the Anti-Lebanon the calcareous banks are more scattered and the cost of transporting the material is considerably enhanced.

The roadbed is renewed on an average once in 3 years, and for this purpose the road is divided into three sections, one of which is remetaled every year; besides this, those parts of the road that are subject to an extra amount of wear and tear, like the approaches to Beirut and Damascus, are regularly watered during the dry season; that is to say, between the months of May and November, while the excessive dust that necessarily accumulates is removed from time to time with wooden scrapers. Ditches are running along both sides of the road, which are kept in good order to prevent the submersion of the roadbed, and when snow obstructs the highest and most exposed parts of the road in the Lebanon, it is cleared away by digging trenches to make a passageway for traffic.

COST AND MAINTENANCE OF THE ROAD, ETC.

The total cost of building this roadway, which has an average width of 6 metres, and is $70\frac{5}{8}$ miles long, was 1,885,969.54 francs ($377,193.91), or 16,690 francs ($3,338) per kilometre; the land acquisitions amounted to 110,652 francs ($22,130.40), or 989 francs ($197.80) per kilometre. The company also expended 698,713 francs ($139,742.60), or 6,238.50 francs ($1,247.70) per kilometre for buildings, etc., so that the entire cost foots up 3,000,000 francs ($600,000).

The company has a yearly average outlay of about 100,000 francs ($20,000), or 893 francs ($178.60) per kilometre, for repairs, etc., to the roadbed, etc., and its annual net revenue is between 450,000 and 500,000 francs ($90,000 to $100,000).

TRAFFIC OVER THE ROAD, ETC.

The average amount of freight that passed over this road during 1885, 1886, and 1887 was 20,700 tons annually. It has, however, increased since then, and in fact is constantly augmenting. The general character of the merchandise transported iucludes the following imports: Iron, all kinds of metals, leather, salt, rice, sugar, petroleum, manufactures, fruits, hardware, etc. The articles exported passing over the road are, principally, flour, wheat, seeds, wool, licorice, textile fabrics, bones, butter, oil, etc.

These goods are transported in covered wagons or carts, each being $3\frac{1}{2}$ metres long, $1\frac{1}{10}$ metres wide, and $\frac{8}{10}$ metre high, and weigh, when empty, 700 kilograms; loaded, 1,500 kilograms. This wagon load of only 800 kilograms may appear light, but it must be borne in mind that the road traverses Mount Lebanon at an elevation of 4,630 feet, with some very steep grades. The number of these freight carriages that pass daily between Beirut and Damascus is 28, 14 each way, each of them being drawn by 3 large mules.

Besides the freight traffic th ere is a "diligence," or omnibus, leaving both Beirut and Damascus every morning, weighing 1,500 kilograms. These "diligences" are capa ble of accommodating 16 persons in winter and 18 in summer, allowing e ach passenger 12.820 kilograms of baggage; they are drawn by 3 horses and as many mules.

There are also two "mail" omnibuses passing daily over the road, one from Beirut, the other from Damascus; their weight is 750 kilograms each, and they carry 5 passengers, entitled to 6.410 kilograms of personal baggage; 3 horses or 2 horses and 1 mule are sufficient to draw them.

EFFECT OF THE ROAD UPON LAND VALUES, ETC.

The effect of this highway upon land values has not been very marked, owing to the arid nature of the land traversed and to the absence of villages and scarcity of water along its line, though both the outskirts of Beirut and Damascus are largely benefited.

But the result proved entirely different to commerce. The facilities of communication and the reduction in the cost of transportation have developed the traffic to five times its former proportions, and Beirut, with a population of only 25,000 souls in 1860, now claims 120,000 inhabitants. Damascus has remained nearly stationery in so far as its population is concerned, but its traffic has greatly augmented.

STREETS IN SYRIAN CITIES.

The streets of the different cities of Syria are fully adapted to surrounding conditions and circumstances, but they do not contain any elements or features that would prove of value or even interest in this report.

ERHARD BISSINGER,
Consul.

UNITED STATES CONSULATE,
Beirut, February 10, 1891.

CONTINENT OF AFRICA.

EGYPT.

REPORT BY ACTING CONSUL-GENERAL GRANT, OF CAIRO.

STREETS OF CAIRO.

The new or improved city streets and avenues of Cairo are generally roads bordered by sidewalks. In the country the sideways are simply formed by earth thr own on each side of the road. The city roads are constructed on the Macadam syste m. An experiment was made to build a road with asphalt, melted and poured hot on a bed of broken stones. The result was bad.

Another experiment was made with slabs made of a concrete composed of broken stones m ixed with liquid natural asphalt. The result was better than with the pre ceding method.

Finally, a wooden pavement, made of pine wood resting on a solid area of concrete, has proved satisfactory for more than one year since it was placed on one of the m ost frequented roads of Cairo, but it is expensive.

The macadamized roads are generally built of small stones, forming a bed 0.25 metre thick. T he agglomeration of the materials is produced by means of a steam comp ressing roller on the Gellerat (Paris) system, and weighing 18 tons. In few instances compressors drawn by animals are used; but the work is not so well done.

The cost of building macadamiz ed roads is from about 59 to 74 cents per square metre.

When small repairs are needed they are simply made by laborers, but extensive repairs are made by laying over the surface of the road the quantity of new materials necessary to restore it to its former thickness.

The expenses incurred on account of the ordinary and extraordinary repairs of the macadamized roads of Cairo, including work and materials, amounted during the year 1889 to $82,548 for a surface of 952,500 squares metres, or $8\frac{3}{4}$ cents per square metre.

These expenses do not include the watering of the roads, which is done twice a day during the summer and once a day during the winter.

The length of the macadamized roads of Cairo, not including public squares, is 58 miles, while the other ordinary roads have a length of 132 miles.

EFFECTS OF IMPROVED PUBLIC ROADS.

The value of lands through which the new roads have been laid has considerably increased, and in the northern side of the city, at Zaher, it is at least ten times greater.

Twenty years ago ground in the Ismailieh district was granted free under condition that dwellings would be erected on it; but as at that time there were no roads made in that part of the city, many of the grantees did not care to spend money for building, and they let their concessions lapse; but as soon as roads were built there was a greater demand for the land, and nowadays it is sold at $10 a square metre.

Eight or nine years ago some bankers bought land from the Government in the Tewfikieh district at $1.88 per square metre, and now the average price is about $7.40.

The above figures demonstrate the effect of created or improved public roads upon land values.

Twenty-five years ago there were no hackney coaches at Cairo, on account of the difficulty of circulation in the interior or exterior roads of the city. Distances were traversed on horses, mules, donkeys, or camels.

The work of improvement of roads began in 1868, and in a space of ten years the actual system of streets and roads was completed. Such improvements have greatly facilitated commercial transactions and considerably increased the value of estates bordering the great avenues which have been opened in the old part of the city.

Public health has greatly improved in consequence of the creation of new quarters in the western and northern parts of the city.

These parts were formerly covered with huge heaps of rubbish, the dust from which, raised by the least breath of wind, was blown all over the city, causing diseases of the eyes, lungs, etc. The wide avenues opened in the midst of narrow and tortuous streets have produced an effective drainage conducive to the salubrity of these streets and lanes.

Thanks to the creation of new districts and to the opening of large avenues in the old city, Cairo has become a city pleasant for everybody in general to live in, and especially for foreigners.

HIGHWAYS.

In the several towns of Egypt, except Cairo and Alexandria, there are very few metaled roads. The others are merely of beaten earth, kept wet and smooth, and, considering the climate and the smallness of the traffic, they answer sufficiently well.

Until two years ago it may be said there were no country roads at all, and it would have been impossible to convey agricultural produce on a wheeled cart from one center of population to another.

A beginning has been made, however, first in Dakahlieh and Sharkieh and then throughout the other provinces, of constructing simple

unmetaled roads, 5 metres wide, with bridges over the canals, leading generally to railway stations or sometimes to points on the river. Their construction is being defrayed by a local tax not exceeding 20 or 25 cents per acre for 1 year only. They are maintained afterwards at government expense. It is too soon to pronounce yet on the value of these roads, but they are very popular among the people.

The information contained in this report was kindly given me by the department of public works.

LOUIS B. GRANT,
Acting Consul-General.

UNITED STATES CONSULATE-GENERAL,
Cairo, April 9, 1891.

MOROCCO.

REPORT BY CONSUL-GENERAL MATHEWS, OF TANGIER.

Morocco furnishes no material whatever for framing such a report as desired through your Department.

There are no roads in this country, no railroads nor vehicles of any sort.

The narrow and crooked streets of the cities and towns of Morocco are partly paved with rough cob stones, which makes walking a difficult task. The roads are only trails made by the passing and repassing of animals. In fact the Government discourage instead of encouraging the building of roads, and ever oppose the paving of the streets of certain towns.

F. A. MATHEWS,
Consul General.

UNITED STATES CONSULATE-GENERAL,
Tangier, January 22, 1891.

ST. HELENA.

REPORT BY CONSUL COFFIN.

The streets, of which there are but two on the island, one leading from the seaside, a mile or more up the valley, to the head of the town, the other, a short street of a few hundred yards, branching off the main street and leading to the Longwood road.

They were built many years ago with slave labor by different governments and the old East India Company from material taken from the side hills, consisting of stone or lava and clay or mud.

The hills are composed of alternate layers of the above material in layers of from 2 to 10 feet or more in depth, of a volcanic formation.

The stone is broken and put on the streets and covered with mud or clay; they are repaired with the same material and in the same manner. As it is not rolled down, in dry weather it is very dusty and in wet weather very muddy.

The roads, of the same material as the streets, are built along the side hills by leveling and building a stone wall on the off side of the road to prevent the carriages and travelers from going over, as the hills are very steep, and they would, in many places, be thrown some hundreds of feet to the bottom of the hill. These roads make sharp turns in the shape of a V in their zigzag routes to the top of the hills, and to go a short distance you travel many miles; by any road from Jamestown it is laborious for man or beast, as it is a continual ascent for 2,000 feet; then there is some level road interspersed with steep hills. Carriages and teams all use shoes for one of the hind wheels, and with a single carriage a man leads the horse, as it is not safe to drive by reins, the hills are so steep; double carriages are driven by a postillion who rides one of the horses, with a boy following to put on the shoe when necessary.

The roads and streets are kept in order by the soldiers belonging to the engineer corps; as their number has been reduced, very little is done on the roads or streets now. There are a great many miles of roads around the island, which must have cost, even with slave labor, an enormous amount of money to build, as many miles of blasting and wall-building had to be done. The actual cost of these roads can not be ascertained, as they have been built by the different governments which have had possession of the island.

There is no doubt that these roads when built increased the value of property along their route, but in the present state of the island, which is fast decaying, they have no effect, as the country seats along their route are many of them vacant and in ruins, and the farming land turned into pasture, and of little value.

The primitive manner of construction and the material used are such that I should not think they would be of any interest or benefit to the inhabitants of any part of the United States.

JAMES B. COFFIN,
Consul.

UNITED STATES CONSULATE,
St. Helena, January 24, 1891.

SIERRA LEONE.

REPORT BY CONSUL BOWSER.

The streets in this colony and city are all alike. There is an underlying bed of soft calcareous rock, with various depths of earth, from 3 to 5 feet. The roads are made by digging trenches on each side, and throwing the dirt to the center and leveling, then a top dressing of

broken stone completes the street or road. As there are but 2 horses and 1 dogcart in the colony, the roads are easily kept in repair when only naked feet tread them.

The roads that lead far into the country are nothing more than narrow paths, as all travelers go single file. The cost of maintaining the roads here are the filling up of some ruts that may be caused by washouts during the rainy season. You will readily see that roads and street making are of little expense in this country.

BOLDING BOWSER,
Consul.

UNITED STATES CONSULATE
Sierra Leone, December 29, 1890.

AUSTRALASIA.

NEW SOUTH WALES.

REPORT BY CONSUL GRIFFIN, OF SYDNEY.

CITY STREETS.

The streets and roads of New South Wales are partly made and managed by the government and partly by the municipalities. The number of miles of streets and roads owned by the municipalities at the end of 1889, the latest statistics available, was 5,790. Of these 2,799 were regularly formed and metaled and 2,991 were not formed. The cost of their construction, or their estimated value, is given by the government statistician at $17,959,455. The length of the streets and roads in Sydney and the suburbs was 1,568 miles, 115 miles of which are included within the boundaries of the city. The boundaries, however, do not include anything like the total area of the city. The estimated population of the city and suburbs within a radius of 10 miles is close on to 420,000, whilst the population of the municipality is only about 230,000. Nearly all the streets and roads of the city are formed, curbed, and bordered by pavement of asphalt, tarred stone, artificial stone, etc. About 300,000 square yards of the city are paved with wooden blocks, or about a twenty-second part of the entire area. These blocks are laid wherever the traffic is heavy enough to require a superior pavement. The macadamized or metaled pavement, being less expensive, seems to answer very well for the purpose of light traffic.

CONSTRUCTION AND MAINTENANCE.

Both the government and municipal authorities advertise for tenders for the construction of streets and roads over which they have control, and the contracts are given to the lowest and best bidders. Great care is exercised in awarding these contracts. The specifications are very full and the execution of the contracts must meet with the approval of the authorities.

In Sydney, if at any time the work is not carried out in strict conformity with the contract, the city surveyor will interfere and inform the contractors that if not remedied the municipality will take the work out of their hands.

Parties tendering for contracts must deposit the sum of £20 ($97.35) on or before the time specified for the reception of the tenders. The deposit will be returned in all cases of nonacceptance, and to the per-

son whose tender has been accepted when he shall have completed his work according to the requirements of the bond he is called upon to give.

TARRED METALED PAVEMENT.

The material employed in the pavement of streets for light traffic consists principally of bluestone or metal, of which there is an inexhaustible supply in the colony. The foundation of the pavement must be approved of by the city surveyor. Where rock exists too near the surface to receive the ballast it is to be broken up and loosened to a depth of at least 8 inches below the level of the underside of the ballasting. The foundation is properly consolidated to a uniform depth of 9 inches, and a coating of new hammer-dressed rough pitchers of the hardest description of sandstone laid lengthwise across the road in close and regular rows, breaking joint. As rough pitchings are well rammed, the breadth of the upper edge must not be more than 7 inches, with a length of from 12 to 15 inches. All the interstices are filled in with stone chippings firmly wedged, well keyed in, and blended with sand well shaken into joints by ramming. The stone for the ballasting is broken to a 2-inch gauge, 2 inches thick, and covered with a coating of tar. It is then rolled to a finished grade and an additional layer of the same material, prepared in the same way, is spread to a depth of 3 inches and again rolled. The whole is cemented together in one unbroken mass by a covering of tarred screening. The latter is made even in thickness and solid after which a thickness of 1 inch tarred screening of the finest bluestone and dust from the crushings is put in as a finishing coat.

WOOD PAVEMENTS.

The authorities of Sydney before entering upon the extensive construction of the magnificent roadbeds of the city made the most careful inquiries as to the various kinds of pavements in use in the principal cities of the world, and a series of costly experiments were made with the kinds generally regarded as the best in use. These included granite-set pavements, monolithic, sheet asphalt, wood pavements, etc. It was their desire to get a pavement with a due regard to economy or cheapness and afford a good foothold, be impervious, durable, noiseless, adapted to various grades, yield no detritus, and offer the least resistance to traction. No particular kind of pavement complied with all these conditions, but the one finally adopted for heavy traffic seemed to come nearer to them than any other. A committee was appointed, composed of some of the ablest physicians and scientists in the colony, to report on the sanitary conditions of the wood pavements that had been in use in Sydney and other places, and although the committee made a sweeping condemnation of all kinds of wood pavements it was shown that the districts in which wood pavements had

been in use for a term of years in Sydney were healthier than those without them.

The committee in concluding their report said:

We beg to express the opinion that wood is a material that can not be safely used for paving unless it can be rendered absolutely impermeable to moisture and so laid that while the entrance of the water between the blocks is rendered impossible the separation of the fibers at the surface by the concussion of the traffic is also effectually prevented. These conditions have nowhere, to the knowledge of the board, been fulfilled. In this city no attempt to fulfill them has been made and the analyses show that the blocks in actual use here have absorbed an amount of organic filth which is large in comparison with the short time during which they have been laid, and which is distributed throughout the blocks in such a manner as to show that their complete impregnation is only a matter of time. The foul and dangerous processes to which this impregnation of the wood gives rise when with it is combined alternate wetting and more or less thorough drying by the sun and the construction which, while it does nothing to exclude the air entirely, of necessity interferes with its free circulation, are well shown by experiment, and it is perhaps well to point out that the use of sea water to lay the dust is so far from tending to prevent these processes that in addition to introducing the organisms proper to seawater where otherwise they would not be found it appears to have given rise to certain forms of life which hitherto have not been recognized, and which flourish in conjunction with the better known forms of both fresh and salt water. In offering this opinion your board has certain advantages which wood pavement offers in comparison with other kinds in mind, and does not lose sight of the fact already here recognized, that every pavement is a compromise. But before a given material or mode of construction can be scientifically admitted as an alternative to other kinds and to other modes, it must be shown that its admitted defects are remediable or that they are of no greater consequence than the defects of every other available material. Neither has been shown in the case of wood, so far as the careful researches of your board go the porous absorbent and destructible nature of wood must in their opinion be declared to be irremediable by any process at present known, nor, were any such process discovered, would it be effectual unless it were supplemented by another which should prevent fraying of the fiber. Still less can the defects of wood be considered to be of less consequence than the defects of other kinds of material. The covering of roadways to a vast extent of surface with decaying vegetable material has been shown in the United States to be a cause of malarial fever, and an aggravation to yellow fever, in a degree of probability which is very high; and these results are such as knowledge of the usual effects of decaying vegetable matter under other but similar circumstances would lead your board to anticipate. Wood, then, should not be accepted as an alternative to other materials; and if in other climates than that of the American cities referred to, and under other modes of construction than are used in Sydney, the same effects are not known as yet to have followed, it must not be forgotten either that wood paving has nowhere been so largely used in proportion to other kinds as in America or that the disastrous and obvious effects noticed in that country are not the only serious effects which wood may cause. In this city it may, perhaps, be considered that an amount of wood has has not yet been laid sufficient to affect the public health, whatever its condition within reasonable limits may be; and upon this ground your board does not recommend that the present paving should be removed, but that the board of health should be empowered to examine it, and to report upon it, from time to time, with a view of ascertaining its behavior under longer exposure to weather and traffic than it has yet had; and that it should be no longer watered but cleansed by sweeping at least twice a day (the sweeping to be done at right angle to the direction of the street, or parallel to the courses, so that the latter may be cleared out by the broom) in order

that destructive dampness and penetration of dissolved organic matter may be reduced as much as possible. But the presumption is, upon the evidence here adduced, that in this climate the results alluded to would ensue if the extent of surface were sufficiently enlarged or fouling and decay sufficiently extensive. Your board therefore recommends that the paving of the streets of this city with wood should be discontinued; and desires to add that this recommendation is intended to apply not to the particular mode of construction here adopted alone, but to the material itself, and to every known method of construction.

In spite of this opinion the authorities soon found that by keeping the pavements clean and in good order all the objections urged were overcome and a decided improvement was noticed in the health of the city. The blocks used for the pavements consists of various kinds of Australian hard wood of the eucalyptus species such as red gum, tallow wood, wooly butt, black butt, blue gum, etc. The wear and tear on these blocks proved slight when compared with the blocks used in the European cities. Blocks taken at random from the center of one of the principal streets in Sydney subjected to very heavy traffic had worn only one-sixteenth of an inch in several years. Samples of the Australian hard woods used for paving the streets were sent to New York by Mr. R. W. Richards, city surveyor. Mr. Richards has for many years been a strong advocate for the use of these woods and his experience and judgment have had great weight with the municipal authorities. The blocks used are cut into cubes of 6 inches long, 3 inches thick, and varying in width from 6 to 9 inches, which limits must not be departed from, except in cases of chasms when smaller blocks may be necessary. The blocks are to be laid on a foundation of concrete 6 inches in depth and composed of the following material, viz, the best brands of cement mixed with either the following ingredients:

First. Gravel and coarse, clean, sharp river sand in suitable and approved proportions the gravel not to be larger than $2\frac{1}{2}$ inches gauge, the concrete to consist of 1 cask of cement to 24 cubic feet of gravel and sand.

Second. The aggregate to be a compound of clean blue stone, mixed with dust and screening obtained from crushing, in the following proportions: 1 cask of cement to 20 cubic feet of blue stone broken from 1 inch to $2\frac{1}{2}$ inches gauge, and 15 cubic feet of fine blue stone screening of not more than five-sixteenths of an inch gauge.

The concrete must be well worked and to a smooth surface, and receive a thin coating of two parts of clean river sand to one part of cement. When the concrete is thoroughly dry the blocks are laid on it as follows: Three rows longitudinally along curbs throughout the whole extent of the curbing; the remainder of the blocks to be laid transversely across the street to form any angle between 30 degrees and 45 degrees, or as the city surveyor may direct. The end of the blocks butting against rows parallel to curbs to be cut so as to form a close and even point. The joints to be separated by not more than one-fourth of an inch, and to be regular and uniform. The city surveyor noticed that

when the joints were too far apart the noise of the traffic was increased, and he directed that they be made narrower. At first they were 1 inch in width and were reduced to three-eighths of an inch, and then to one-fourth of an inch, as heretofore mentioned. In paving George street, the principal thoroughfare of the city, four methods were adopted:

First. Joints of three-eighths of an inch coated with screenings and tar.

Second. The blocks were laid with butt joints dipped in tar and hammered up close and afterwards thoroughly grouted by sweeping boiling tar and river sand.

Third. The blocks were laid on a roofing of tarred felt, jointed with strips of the same material properly hammered up, to render close and even joints.

Fourth. Three eigths joints grouted with pitch, river sand, and tar. The street was opened for traffic in July, 1888, and it was noticed that the noise had been minimized and the slipperyness of the pavement overcome by sprinkling sand upon it. Mr. Richards, the city surveyor, is of opinion that the method of laying the blocks without grouting is by far the best. At first the blocks were painted on all surfaces with hot tar, and stacked for at least 4 hours and then laid in the work, at every twelfth row hammered up close, a plank 12 feet long, 6 inches deep, and 2 inches thick being used as a beating surface. Upon completion of a length of 1 chain the surface was well swept with hot tar, sprinkled with hot sand, and again with tar, sufficient quantity being used to form a plastic paste with which the joint was afterward thoroughly flushed up. After 3 months' traffic upon this section the necessity of an after treatment was apparent, as the joints were gaping, and in some instances the blocks were loosened. The means taken as a remedy were that the blocks were well watered and when fairly dry again the joints swept in flush with sand and tar, as before described; since which, the pavement has maintained a most satisfactory condition, notwithstanding that it has been subjected to the most variable influences. The Castlereagh street pavement, from Hunter to Liverpool street, a distance of 58 chains, afforded opportunity for further experiment, and for a length of 8 chains the blocks were laid at an angle of 45 degrees to the curb, by which a wheel in its revolutions is on at least 2 rows of blocks, and the result showed that the noise occasioned by the jarring over the joints was reduced to a minimum. In the same work a butt-jointed pavement was laid for a length of 7 chains, with a gradient of 1 in 65, and a convexity of 1 in 60. Mr. Richards states when the gradient does not exceed 1 in 40 the butt jointed can be laid with advantage.

The convexity can in such cases be reduced to 1 in 80. In anticipation of expansion of the blocks, a seam of sand 1½ inches wide was laid on both sides of the roadway, between the curb and the blocks. This section has been traveled upon for nearly 12 months and has not yet

required attention. The woods used in these works were of the classes respectively known as black butt, spotted gum, and tallow wood. During the last 2 years portions of the areas, wood-paved, with the wide joint, have been renewed, with the narrower joint. The old blocks obtained from these areas have been utilized in the paving of lanes and narrow ways adjacent to wood-paved thoroughfares. The work was done by days' labor, the foundation being prepared with the best material obtained from the excavation of the former roadway, the blocks bedded on a layer of sand 3 inches in thickness and the joints grouted with sand and tar.

The steepest grade is 1 in 17.2 and is a length of 4 chains. The greatest width of roadway is 275 feet (at George street south, near railway station), in portion of which there is also the greatest cross fall, viz, 1 in 17, which was necessitated to conform with the tramway construction. At first the intersections of the streets were paved with cube settings, but Mr. Richards recommended their removal and wood blocks put in place of them. This plan he pressed continually upon the authorities until it was finally adopted. A careful examination of the work done on George street and on King street afforded an opportunity for comparing the wear of bluestone cubes with that of wood blocks. The bluestone cubes, after having been subjected to traffic for 5 years and upwards, showed an average wear of 1 inch per annum, whilst the wood blocks, which had been put down for a longer period, subjected to an equally heavy traffic, wore only at the rate of 1.26 of an inch per annum. Blocks put down in 1888 under the present system have also been examined and the wear was only at the rate of 1.50 of an inch per annum.

From these results it is estimated that, after making full allowance for depreciation and contingencies, the minimum life of wood pavement is about 16 years, or from 3 to 4 times that of bluestone cube set pavement.

SIDEWALKS.

The pavement of sidewalks or footpaths in Sydney consists of flagging, artificial stone, and tar paving, etc. These pavements appear to give satisfaction.

Under the corporation act of 1879, it was provided that certain portions of the footways should be paved with flagging and others with flagging or tar pavement. The main thoroughfares were to be with flagging and the residential streets with flagging or tar pavements.

At first the average cost of flagging was 14*s.* ($3.41) per square yard and the tar pavements 2*s.* 6*d.* (60 cts.) per square yard. The property owners were charged with the cost of the work, but those on the main thoroughfares objected very seriously to be compelled to pay for flagging whilst it was left to the option of the residential owners to have

either flagging or tar pavements, and the act was finally amended so as to apply equally to both classes of owners.

The tar pavement was most generally in use. Mr Richards, however, stated that the tar pavement is only desired when it is apt not to be disturbed, and he finally succeeded in getting a medium between the two adopted called artificial stone. The following is a description of the method of constructing the latter pavement: The ground being excavated to a sound and approved foundation—an aggregate composed of one measure of cement to two of clean coarse sharp sand thoroughly mixed dry and made into a mortar, with the least possible amount of water—broken sandstone not exceeding 1½ inches in their largest dimensions, thoroughly cleaned from dust and dirt, drenched with water, but containing no loose water in the heap, to be immediately incorporated with the mortar in such quantities as will give a surplus of mortar when rammed. When the proper proportion is ascertained, it is afterwards regulated by measure. When spread it is thoroughly compacted by ramming, until free mortar appears on the surface, which must be made exactly parallel with the surface of the pavement to be laid.

Before this base is thoroughly set a wearing surface 1 inch thick is laid (to a uniform and plane surface and properly smoothed), composed of one part of Portland cement to one part of clean, coarse, sharp sand, cut into diamond or rectangular slabs, in sizes not larger in area than 1 square yard.

In this pavement (from result) it seems advisable at every length of 12 feet to allow a groove 1 inch deep by 1 inch wide, so that the wearing surface should set freely, after which the groove is filled in with asphalt or other suitable material. The scoring is done with a trowel, and cut not more than a quarter of an inch deep, and with a uniform width of one-eighth of an inch.

The traffic in George, Pitt, York, and Sussex streets is said to be as heavy per square yard as in any other city in the world. The average number of vehicles passing George street near the town hall per day for 12 hours is 11,960.

GRANITE PAVEMENTS.

The cubes of the granite pavements are very carefully laid on a concrete foundation of 6 inches in depth. In 1887 there were 600 square yards of this pavement laid at a cost of 22*s.* 7*d.* ($5.48) per square yard, and 337 yards laid on sand at a cost of 15*s.* 3¼*d.* ($3.71½) per square yard. In 1888 about 2,000 square yards were laid on sand, varying in cost from 6*s.* ($1.46) to 13*s.* 10*d.* ($3.48) per square yard. In 1889 there were 2,726 yards laid on sand at a cost of 5*s.* 1*d.* ($1.24) per square yard. In 1890 there were 9,687 yards of wood paving laid at a cost varying from 13*s.* 7*d.* ($3.30) to 19*s.* 4*d.* ($4.70) per square yard. The following table shows in detail the cost per square yard of wood paving carried

out during the years 1889 and 1890; also the cost of cube set paving for 1889 in Sydney:

WOOD PAVING.

When opened to traffic.	Name of street.	Locality.	Area in sq. yards.	Cost per sq. yard.	Remarks.
1889.				*s.* *d.*	
January	Pitt.....	At Spring and Bond streets.	720	16 7¼	Cube-set crossings removed and wood blocks substituted.
Do.....	William.....	At Boomerang and Yurong streets.	82	19 3	Do.
May	George.....	At Gipps, Engine, Hay, and Goulburn streets.	2,980	18 0½	Do.
June.....	Elizabeth....	Hunter to Liverpool street.	11,908	19 8	Hardwood blocks laid on 6-inch concrete.
1890.					
January	Kent.....	Argyle to Crescent street.	6,510	19 10	Do.
April	Pitt.....	At Hunter street.....	562	15 0	Cube-set crossings removed and wood blocks substituted.
July	Bridge.....	Pitt street, Macquarie place.	1,775	19 8¼	Hardwood blocks laid on 6-inch concrete.
June to December.	Clarence.....	At Margaret street..	7,270	13 7	Cube-set crossings removed and wood blocks substituted.
	George.....	At Argyle, Bathurst, Druitt, Hunter, King, Liverpool, and Margaret streets and Queen's place.			
	Pitt.....	At King, Market, and Park streets.			
	York.....	At Barrack, Druitt, Erskine, King, Market, and Wynyard streets.			

CUBE-SET PAVING.

1889.					
July	Alger's road.	.....	625	5 1	Old cubes laid on sand.
May	Stream.....	Myrtle street to Paint's lane.	249½	5 1	Do.
September..	Harbor	Pier to Liverpool street.	1,852	5 1	Do.

REPAIRS.

The cost of repairing wood paving in Sydney is less than that of any other kind when the amount of traffic is taken into consideration.

The total expenditures for repairs to wood pavements is very small. In 1890 considerable expenditures were made on account of the gas company, sewage board, etc., but the general repairs amounted to only £65 ($316.32) during the year.

The city surveyor states that the annual cost for repairs to wood pavements is so small as to be hardly worth taken into consideration, and that the chief outlay is in soundings. The whole expense, for repairs, including the cost of watering the streets, is about one-sixteenth part of a penny, say one-eighth part of a cent per square yard per annum. The annual cost of repairing the macadamized streets is about $8\frac{1}{8}$ cents per square yard. Taking separate areas on streets similarly constructed and over which continual traffic passes in the central part of the city the cost is from 8*d.* (16 cents) to 11*d.* (22 cents) per square yard.

SEWERAGE.

This report would be incomplete without some mention of the admirable system of sewerage that has been so successfully carried out by the authorities of Sydney and which has done more than anything else to improve the health of the city.

In 1875 the government appointed a board, called "the Sydney city and suburban sewage and health board," for the purpose of inquiring into and reporting upon the best means of disposing of the sewage of the city and suburbs, and also for the protection of the health of the inhabitants. The board consisted of fifteen members, including the surveyor-general, several of the professors of the Sydney University and members of the board of health, the city surveyor, the engineer in chief of the road bridges, the government analyst, etc. The board submitted twelve progress reports, all of which dealt with very important questions and contained many valuable and practical suggestions.

In order to understand the system adopted it should be mentioned that the city of Sydney is situated on the southern shore of Port Jackson, about 5 miles from the head or entrance to the harbor from the South Pacific Ocean. Professor Warren, M. I. C. E., of the University of Sydney, to whom I am indebted for much valuable material in the preparation of this report, states—

> That from a point on the ocean cliffs, about three-quarters of a mile south of the South Head, and known as Ben Buckler Point, a high ridge extends in a westerly and southwesterly direction, having a mean elevation above the sea level at its eastern end of about 200 feet and declining thence to about 100 feet. The distance to the north of this ridge, on which the principal portion of the city is situated, drains to Sydney Harbor, and the southern slope drains to Botany Bay and Cook's River.

It was decided that the sewage of those portions of the city of Sydney and its suburbs which naturally drain into Port Jackson should be collected into an outfall sewer and led away by the most direct course and at as low a level as practicable and discharged finally into the sea near Ben Buckler Point, while the sewage of the southern district should be collected into a separate system and taken to Botany and there to be utilized as a sewage farm, there being an ample area of light sandy soil at a convenient level for irrigation by gravitation available for the purpose.

The area drained by the northern system is about 5,300 acres, and the area drained by the southern system about 1,100 acres. The whole of the northern and southern outfall sewers have been completed and much work done in extending the minor sewers in connection with the system. Professor Warren states that the northern outfall sewer commences near the intersection of the Newtown road and Parramatta and discharges into the ocean near Ben Buckler Point, is 5½ miles in length, uniform in section, and varying in size from 4 feet 6 inches by 3 feet 6 inches at its upper end to 8 feet 6 inches by 7 feet 6 inches for a length of 1 mile at the outfall end, with a fall of 3 feet 6 inches a mile. At a

quarter of a mile from the head it is joined by "the Prince Alfred Hospital connecting sewer" and by the "Pyrmont branch sewer;" at the corner of Oxford and Liverpool streets, 1¼ miles from the head, it is joined by the King street and several other intercepting branches. Besides collecting sewerage at these branches it intercepts a number of old sewers at Rushcutters Bay. A storm-water overflow is provided along the entire length, and from this point an overflow sewer was built to carry the storm water into the bay. It is one half a mile in length, 4 feet 6 inches by 3 feet 6 inches in size, with a fall of 1 in 200, and discharging above high-water level. A swamp of 1,000 feet in length had to be crossed by this overflow sewer. This part of the work is carried on arches of 25 feet span and 3 feet 6 inches rise. To form the piers for the arches concrete cylinders of 10 feet external diameter were sunk through the spongy ground until a stratum of clean sand was reached. The cylinders were filled with concrete and the arches turned. The thickness between the soffitt of the arch at the corner and the invert of the sewer is 12 inches. The depth of the cylinders varies from 10 feet to 33 feet. The whole of the work in the cylinders, arches, and sewer is of concrete.

Provision is made at the other points for storm-water relief and diversion of sewerage when necessary. The northern system comprises the following new brick and concrete sewers:

Outfall sewer, 5 miles 2,700 feet; Prince Alfred Hospital intercepting sewer, 1 mile 1,400 feet; Pyrmont branch, 1 mile 2,100 feet; Kent street intercepting sewer, 1 mile 3,900 feet; Bridge street and Harrington street intercepting sewer, 1 mile 4,700 feet; Riley street and Bourke street intercepting sewer, 2,000 feet; Lacrozea Creek branch, 1,500 feet; Rushcutter's Bay overflow sewer, 2,500 feet; proposed extensions to Glebe, Balmain, etc. (shown in dotted lines on sketch plan), 5 miles 2,000 feet; total, 18 miles 680 feet. Some stoneware pipe sewers have also been laid up to 24 inches diameter, and a large amount of work remains to be done in laying pipe sewers or submains. Concrete has been largely used in the construction of the sewers, and all bricks used in the work are of very high quality. The concrete (except that used for packing purposes) is composed of blue stone, broken to a 1½-inch gauge, sand and Portland cement in the following proportions: Four parts of stone, two parts of sand, and one part of cement. The bricks were nearly all supplied from two brickyards, and average samples taken from them were tested at the Sydney University Engineering Laboratory with the following results: Average crushing resistance per square inch, 2,782 pounds and 2,228 pounds. The crushing resistance of English Stourbridge fire bricks is about 1,717 pounds per square inch, and of London red brick about 808 pounds per square inch. The tunnels are lined throughout, the minimum thickness of lining adopted being 4½ inches. In rock tunnels the lower part of the sewer up to a height of 12 inches above the springing level is lined with bluestone concrete, and the arch is closed with brickwork packed solid to the rock with sandstone concrete. In very wet rock a ring of brickwork (4½ inches) is laid inside an outer lining of concrete and subducts, which were afterwards closed, were used during construction in order to secure water-tight work. The outfall sewer from Oxford street to the ocean, a length of 4¼ miles, is rendered to three-fourths of its height, and the brick arch above that level is pointed. The remainder of the outfall sewer and the branch sewers are rendered all round with cement mortar, composed of one part Portland cement and two parts of sand. Every lot of cement brought on the work is tested at the head office, where complete testing ap-

paratus is provided, and all cement which does not fulfill the specified conditions, or appears to be of inferior or doubtful quality, is rejected. The sewers are constructed chiefly in tunnels, and a great portion of the tunneling is in sandstone rock. Numerous shafts were sunk for the driving of the tunnels, and to be used for ventilation afterwards, the deepest one being 240 feet. The rock tunnel excavation was done by blasting and presented no difficulties. In some cases the drilling was done by percussive rock drills worked by compressed air, and where compressed air was used for this purpose it was also used to work the winding engines. In other cases the drilling was done by hand and ventilation was provided by Root's blowers.

Professor Warren states that the portions of the work which present most interest from an engineering point of view are on the outlet end of the outfall sewer. For 1 mile, commencing at the outlet, the sewer is 8 feet 6 inches by 7 feet 6 inches, and for the remainder it is 8 feet 2 inches by 7 feet 2 inches. It is constructed in tunnel on sandstone rock on this length for 3,960 feet, and in water-charged sand 1,643 feet, and in open cutting in water-charged sand for 2,967. This part of the sewer Professor Warren states is very interesting on account of the novelty of the design, there being nothing like it as far as he is aware hitherto constructed. He says:

For draining the water charged sand nine centrifugal pumps were used with 6-inch to 9-inch pipes. Pumping wells were sunk to one side of the sewer trench and close timbered to the foundation level; the sumps below this level, a few feet in depth, being steened with concrete to prevent any water entering except through a pipe built in the concrete and connected with the subduct laid along the center of the sewer trench and tunnels. The subduct consisted of 9-inch earthenware pipes laid in hard wood boxes open at the top and packed with broken stone. These boxes were made water-tight, and the sides were carried up about 2 inches above the foundation level so as to prevent any water entering from below that level, except at the end of the duct, which was always kept some distance ahead of the concrete work. During the construction of the sewer, openings through the concrete were left over the subduct at intervals of 200 feet, and lines with rakes attached were passed through from one to the other, and these lines were occasionally pulled backwards and forwards to keep the pipes clear of silt or other obstruction. Two traveling cranes with 30-feet jibs were used for raising the sand from the trenches, which were sunk with a batter of one in eight and close timbered at the sides.

The main southern section of the sewer drains the southern slope of the city, including several of the most important boroughs, the area being over 1,100 acres. The cuttings in some places are 30 feet deep. Professor Warren says that where the sewer passes over natural water courses concrete culverts have been constructed through which the streams are carried under the sewer, so that the land drainage and the interest of market gardeners are not interfered with. The main sewer is constructed of bluestone lined with brickwork and sandstone concrete. For the lower portions, it is rendered on the inside with Portland cement mortar half an inch thick in the proportion of one part of cement to two of sharp, clean sand.

The sewer is provided throughout its length with ventilation manholes and with gas check valves to prevent the sewer gas rising to the higher levels; also with flushing and penstock chambers. Three

million bricks and 35,000 casks of cement were used. In connection with the system a sewage farm of about 300 acres of loose ground has been secured for the purpose of filtering the sewerage. Suitable filter beds have been made for the disposal of surplus water during heavy rains. These beds are capable of filtering 400,000 gallons of sewage per acre in 24 hours. They are used in rotation that the very best filtering powers may be obtained. There are cultivated areas on the sloping ground toward Cook's River formed in terraces on the ridge and furrow system connected with the main carrier by means of small wooden distributors, with sluices, timber boxes, etc. The sanitary results are shown by the purity of the effluent water. The terraces and banks of the main carrier are planted with *Mecembryanthemum tigrinum*. The prepared beds are planted with sorghum, barley, lucerne, etc. This farm, together with many other valuable improvements, not usually connected with sewage, has done much towards making this great work almost unique as well as one of the most complete and satisfactory systems of drainage in the world.

HIGHWAYS.

The public roads in New South Wales, and, indeed, in all the Australian colonies from the first settlement of the country, have been built in the most substantial manner. At first they were constructed entirely by prison labor. The New South Wales road department was organized in 1857, and Mr. T. A. Coglan, the Government statistician, states that although good service was done by the road pioneers before that date, the modern system of road making may be said to have begun with the creation of the roads department. It was not known until 1867 that the whole of the roads received attention at the hands of the state. The department of roads has also the control of the bridges, ferries, punts, etc. Among the duties devolving upon the department are the selection of the work and the disbursement of the funds noted annually for the purpose. Prof. W. H. Wassen, M. I. C. E., professor of mechanical and civil engineering in the University of Sydney, has summarized the duties of the roads department as follows:

(1) The removal of all complete interruptions to traffic, more particularly to mail transit, by bridging the rivers and creeks.

(2) The improvement of all the most difficult mountain passes and swamps.

(3) The final determination of the direction of the roads and the clearing of the same, followed by drainage and culverting where most required.

(4) The forming and metaling of roads, excepting where municipalities exist.

It being almost impossible to insist on any one uniform mode of constructing the roads it was decided to adapt them as far as possible to the conditions of the country through which they were to pass, with a due regard to the requirements of the traffic and the quantity and quality of the material available.

The following are the main roads in New South Wales:

Northern road—length, 405 miles, from Morpeth to Maryland, New England.

Western road—length, 338 miles, from Sydney to Warren, through Bathurst, Orange, and many other important townships; thence prolonged to the Darling, at Bourke, by a line 175 miles in length.

Southern road—length, 385 miles, from Sydney to Albury. This road was, before the construction of the railway, the great highway between Sydney and Melbourne.

South coast road—length, 250 miles. This road, after leaving Campbelltown, ascends the coast range, along the top of which it runs as far as Coal Cliff. It then traverses the Illawarra district, parallel to the coast, and passes through the rich lands watered by the Shoalhaven, Clyde, and Moruya, as far as Eden, at the southern limit of the colony.

The public roads have nothing like the importance they formerly possessed previous to their having been superseded for the most part by the railways. The tendency now is to make the roads act as feeders to the railways by conveying the traffic from outlying districts towards the convenient stations along the railway line. The length of the roads are estimated at about 30,000 miles; of these 6,500 miles have been formed, metaled and graveled, and 4,500 miles not metaled, but drained, and upon which culverts have been built, and 7,600 miles of road through the forests of the interior marked out by cart wheels, and 1,400 miles through mountain passes, some of which presented difficulties almost immountable, and in their construction great engineering skill was displayed. Of these roads much attention has been directed to that at Bulli Pass. This great work was begun in 1867 for the purpose of opening up communication with the northern part of the Illawarra district and the Great Southern Railway at Campbelltown. The Illawarra district is regarded as the garden spot of the colony, and is remarkable not only for its fertility but for the beauty and variety of its scenery. In some places the grades are as steep as 1 in 8, but the road is perfectly straight and smooth. Another magnificent road is that around Mount George, in the Blue Mountains district, and connecting with the main road leading to the Jenolan Caves. The scenery along the road is varied and picturesque in the extreme. Although approaching very near the edges of precipices several thousend feet in depth, strong stone facings of sufficient height protect the traveler from danger and keep the roads from falling away during heavy rains.

CONSTRUCTION AND MAINTENANCE.

The colony is divided into fifty-four road districts and four hundred road trusts. The districts are managed by superintendents or engineers. The trusts have the supervision of certain grants for the maintenanee of roads of minor importance. There are also a number of important road trusts in the vicinity of Sidney all of which are well managed.

Annually votes are obtained from Parliament. First, for the main roads referred to, and secondly, for such of the minor roads as may be considered of sufficient importance to be specifically dealt with, in

which case each road is described by name and placed upon a schedule having a certain sum of money allotted to it according to importance. In addition to these votes, a considerable sum is annually voted under the head of unclassified roads. This amount is distributed by the minister for public works for expenditure, upon representations made, and after report of the officers referred to.

Special votes are made for the erection of bridges by Parliament, and also for repairs to same.

Funds having been thus allotted, road superintendents submit proposals for expenditure to the supervising engineer, who directs the calling for tenders for the various works approved of by them.

Specifications and plans are exhibited at the court-houses nearest the site of the work and advertisements inserted in the local newspapers inviting persons to send in tenders by a stated date.

Tenders having been received by the local officer are submitted by him with his recommendation to the assistant engineers, who have power to accept tenders for any amount not exceeding £200. Tenders above that amount are submitted to the minister for works for acceptance. The lowest tender is accepted in every case unless some special reason exists for passing it over. A tender having been accepted, the papers are returned to the road superintendent that he may obtain the signature of the contractor to his contract.

There are two forms of contract agreement used—a memorandum of task agreement for all sums under £200, and a penal bond for all sums over that amount with sureties in 10 per cent. on the amount of the contract.

The road superintendent prepares these agreements on printed forms, and when signed the bond is sent with all papers to the head office of the branch through the supervising engineers to be filed.

In case of task agreements the butt remains in his possession in the task book, the duplicate coupon is sent on to the head office with previous papers to be filed, and the triplicate, signed by the superintendent, handed to the contractor. (Sample copy attached.)

All contractors are bound by printed general conditions, which form part of their contract papers, and are in all cases attached to the specifications and signed by the contractor.

The contract having been signed, the road superintendent directs the contractor to commence the work.

As the work proceeds progress payments are made from time to time to the amount of 80 per cent. upon the value of the work done, upon the certificate of the superintendent, countersigned by the supervising engineer, and the balance upon the completion of the contracts.

Each road superintendent has also a public bank account, into which are placed moneys for payment to contractors and others as advised from the engineer-in-chief's office. The road superintendents are also held responsible for seeing that the votes of Parliament are not ex-

ceeded, and have to furnish, quarterly, a return, showing the financial position of the district, the balances to credit of votes, and the liabilities incurred against each.

The same routine is carried out with regard to bridge contracts. On all important bridges, the plans having been prepared by the engineer for bridges, an officer is stationed during the progress of the work, whose duty it is to see that that work is faithfully carried out, and certify to pay vouchers. This officer is responsible to and corresponds with the supervising engineer.

In cases of smaller bridges of simple design the road superintendent alone exercises supervision.

To the road superintendents, as stated before, is deputed the duty of submitting proposals for works to be carried out each year, and they prepare the necessary levels, sections, and working plans, for the ordinary formation and grading, or it is done by qualified surveyors under their direction, subject to the supervising engineer, to whom is submitted all proposals with specifications for approval before further action is taken. Wherever possible, levels are taken and sections prepared for grading the roads where construction is to be carried out. Lately a number of surveyors have been appointed for this purpose, as it has been found to be too great a tax upon the road superintendents' time, and took them away from their duties of supervision.

These surveyors travel about from district to district for the purpose of carrying on necessary surveys as may be required.

The very small wooden culverts are now, in the districts within reasonable reach of the railways, to a great extent abandoned in favor of earthenware drain pipes, which are now largely used. The sizes of these pipes are usually 12 inches, 18 inches, and 24 inches in diameter.

These are in 2-foot lengths, readily transported, quickly fixed, last an indefinite time, and form an effective and inexpensive culvert. The roads are usually formed 27 to 30 feet in width where the cross section of the ground is moderately flat and favorable, and where it is steep or rocky, making formation expensive, such as in mountain country, the width is reduced to 24 feet, 20 feet, and, in exceptionally bad country and where only small traffic may be expected, even 18 feet wide.

Metaling is usually 18 feet in width, the quantity of metal being from 1 cubic yard to the linear yard of road on all ordinary roads to $1\frac{1}{2}$ cubic yards on roads where exceptionally heavy traffic exists or the soil is bad and soft.

The size of metal used in construction is usually 3 inches gauge, and it is usually laid on the earth formation without bottom ballast or pitching.

The metal is then blinded with gravel if procurable, or if not, with the best gritty material procurable within reasonable distance.

In some instances in the black-soil country where the ground is flat and water readily absorbed, so that a bad base for the roads exists, a

foundation of brushwood is laid and covered with a layer of better soil, such as shale, to a depth of 6 inches to receive the metal. This practice is not, however, common. In districts where good gravel exists this is largely used in lieu of stone on the ground of economy. A good, smooth road results, carrying light traffic well.

Before the extension of the railways into the more remote parts of the colony the three great trunk lines of road and their principal branches carried the traffic into the interior.

These trunk lines were the Great Northern, the Great Western, and the Great Southern roads and extending about 300 miles inland.

They have been each metaled from 200 to 300 miles.

The method employed to maintain was to place men, styled maintenance men, along the roads, giving each a fixed length varying from 4 to 10 miles. Their duty was to keep the surface good by spreading metal, raking in ruts as the surface became broken by traffic, attending to repairs to culverts, etc.

The supply of metal for maintaining the road was provided by annual contract, let at the beginning of each year, each contract extending over a stated length of road, the metal being supplied in heaps in such places as might be directed and there measured, the spreading being sometimes part of the contract, at others it was spread by the maintenance men.

The same system is, with modification, still in use; but it has been found that the trunk lines of road, being superseded by railways and there not being so much traffic on the branch roads severally, the work of maintaining the surface on these branches is not so costly per mile as upon the old trunk lines; therefore the maintenance men are frequently itinerant; still the same general principle is adhered to.

The maintenance men are paid at a uniform rate of 7*s.* 3*d.* per day, which is to cover repairs to tools, supplied in the first instance by the department. A code of rules and instructions for the maintenance men is supplied to each; to them they are required to adhere. (Copy attached). These men are directly subordinate to the road superintendent and engaged or discharged by him.

During the last 16 years the government have constructed 55 miles of earthernware culverts and 25 miles of lumber, brick, and concrete culverts. The government now largely use iron culverts, with rolled girders and buckeled plates, from 4 to 35 feet span, the floor of the plates being filled with concrete. Mr. P. Scarr, one of the assis tant engineers, in a report bearing date 21st of December, 1890, reviews at length the condition of the roads in the southwestern division. He states that in the maintenance of existing roads there is great room for improvements. He directs especial attention to the condition of the metaled roads, mountain cuttings, drains, water tables, culverts, etc., as being badly in need of repair. The system adopted for maintaining the main trunk lines of roads in years past, when the whole traffic of

the interior passed over them, is not suitable for the extensive ramification of the minor roads which now carry the traffic to the railways and principal centers. Except in very few places the traffic is nothing like as heavy as that of the old trunk roads. The system in vogue then, of placing solitary men upon definite lengths of road, is out of place now. He says:

> Then, under the very heavy and constant traffic, these men were regularly and continually employed in surface repairs, and were visited, if not at regular at least at frequent intervals. The officers had as a primary duty the maintenance of the main lines, so that they became so intimately acquainted with the lengths of road that they could estimate accurately the quantity of metal required on each and the number of men for each length of road. So that this system of having solitary men was perhaps the best that could be devised.

He says, further, that from the large extent of road comprised within each road district it is not possible for the officers to see these men often enough to enable them to judge whether they exert themselves or not. Although an enormous sum is paid away annually in maintenance wages, the maintenance of the work is by no means such as it should be. Value is not obtained for the money paid. Following upon this state of things the metaled lengths are imperfectly maintained, cuttings scoured by water, drains choked by vegetation, and culverts out of repair. It is impossible to lay to the charge of the officers these results. It would be going further into the mire for them to put on additional men to do the work. He proposes as a remedy the reduction of the number of the solitary men, and to form flying gangs who shall travel throughout the districts, each to have in a regular way a general circuit and perform all the necessary repairs periodically. He recommends that in forming these gangs the men at present employed should be absorbed as far as practicable, and that those remaining should act as watchmen over these gangs and receive a slight increase of pay above the others, and make them responsible for the proper working of the gang. By this means 50 per cent. more work, he says, could be done for the money now expended. Mr. Scarr states that in order to test this plan he placed a number of experienced officers in two districts, who have been at work several months with such favorable results that he decided to recommend its general adoption. Among the improvements brought about in the southwestern division by Assistant Engineer Scarr has been to make all parts of the road districts more accessible than formerly to headquarters, and at the same time keep in view the relative importance of the several roads and the facility afforded by the railway for getting at the points of destination. The Gundagai district has been considerably reduced by cutting off from it a number of roads lying to the east of it and throwing them into a new district of Cootamundra. This reduction amounts to 147 miles of road and an expenditure of $13,345 annually on scheduled roads. From Yass has been taken 102 miles of road, with an expenditure of $5,285; from Wagga district 55 miles, at an expenditure of $2,500. The Coota-

mundra district now embraces 425 miles of road at an expenditure of $30,275. The result of this rearrangement is shown in the following table:

District.	Officer.	Mileage.	Expenditure.
Goulburn	Mr. Kuwan	466	$39,245
Crookwell	Mr. Bawden	342	35,850
Yass	Mr. Nielley	449	30,500
Young	Mr. Moriarty	498	35,000
Gundagai	Mr. Frazer	335	91,450
Tumberumba	Mr. Allman	284	40,250
Wagga Wagga	Mr. Taylor	369	25,300
Albury	Mr. Smyth	646	45,300
Deniliquin	Mr. Beere	973	43,400
Hay	Mr. Chisholm	646	36,900
Cootamundra	Mr. Cox	425	30,525
Total		5,431	

Mr. Scarr says these tend to equalize both the mileage and the expenditure as much as possible, but it is to be remembered that the mere statement of mileage and expenditure must not be taken as complete evidence of the amount of work entailed upon each officer when comparing one district with another. Regard must be had in doing this to the nature of the country as to the facility of getting about, the importance of the roads and work to be supervised, and the relative position of the various roads. With the exception of the Gundagai district there is not any material difference in the amount of the expenditure. In this case the disproportion to the amount to be disbursed in the other districts is caused by the special grant of $60,000 for the road from Tumut to Kiandra, now in course of expenditure. This will be carried out during the present year, when the amount for that district will again fall to its normal amount. In the Albury district, where the works are important, the expenditure is slightly over the general average, but here a senior and experienced officer with two assistants are stationed.

EFFECT OF IMPROVED PUBLIC ROADS UPON LAND VALUES.

There can be no doubt that the improvement in the conditions of the roads from time to time has exercised a material influence upon the value of land throughout the country. In some districts as a consequence of this improvement it is found that produce (grain, for example) can be profitably carried considerable distances to market or to railway stations on the way to market.

In some cases maize is carted 20 to 30 miles by a good road to a railway and sent 250 miles to the metropolis, with a result remunertive to the grower, whilst in other districts where the soil is equally rich, the same grain can only be carted at a loss a less distance to a seaport 300 miles distant from the same market, in consequence of the unimproved condition of the roads.

A consequence of this is that much land which would otherwise

remain in a primitive state now is brought under cultivation and supports population enjoying the privileges of advanced civilization.

In other industries, too, the effect of the better state of the roads is felt. Mining, grazing, etc., are carried on to greater advantage and the benefit of this condition is felt.

G. W. GRIFFIN,
Consul.

UNITED STATES CONSULATE,
Sydney, March 12, 1891.

ROADS IN NEW SOUTH WALES.

[Inclosure in Consul Griffin's report.]

Under Secretary Barling to Consul Griffin.

PUBLIC WORKS DEPARTMENT,
Sydney, March 23, 1891.

SIR: With reference to your letter of the 26th ultimo, and to mine of the 6th instant, I am directed by the secretary for public works to forward herewith, in compliance with your request, a copy of the report of Mr. E. J. Statham, supervising engineer, No. 1 Roads Division, which it is hoped may prove of service for the purposes you require.

I have the honor to be, sir, your obedient servant,

J. BARLING,
Under Secretary,
Per D. A. W. T.

G. W. GRIFFIN, Esq.,
Consulate of the United States, Sydney.

GENERAL REPORT NO. 1 DIVISION.

To the COMMISSIONER AND ENGINEER-IN-CHIEF FOR ROADS:

SIR: In submitting my general report for the past half year I would explain in the first instance that delay in furnishing that report is due to a number of circumstances tending to bring about that result, principally the derangement of affairs consequent upon removal to Sydney, the necessity to personally visit portions of the new district with which I was unfamiliar, the disentanglement of business formerly in my charge now transferred to another division, the continued attention to those matters until such other division could be entirely taken up, the reorganization of my new district, and more especially the press of current business which has constantly demanded more than the regular office hours. My former division extended along the north coast from the Manning to the Queensland border, with Grafton as headquarters. It included the road districts of the Manning, Macleay, Bellinger, Grafton, Clarence, Lismore, Casino, and Tweed. A short experience of the division as thus arranged demonstrated the utter unworkableness of some of the districts, due to extension and ramification of new roads and development of fresh centers for settlement. In recognition of the necessity to meet the altered circumstances the Manning and Macleay have been relieved by the introduction of a new district, with Port Macquarie as its center. The Grafton district has been divided into two, designated Grafton and South Grafton; and Lismore has also been divided by making another, with Woodburn as headquarters. Under this new development Grafton,

never a convenient center, became more than ever unsuitable as divisional headquarters; and notwithstanding every effort vexatious delays have resulted, no doubt contributing to the discontent which has lately been the subject of inquiry. The same causes operating more or less over the whole colony, a thorough reorganization became a necessity, and under the new arrangement my division has been modified by a curtailment of its length on the coast, and the additions of a portion of the table land, bringing it in touch with the railway system and the principal postal routes, resulting in a vast improvement as respect the rapidity with which the business can be dispatched and any particular place visited.

As now constituted my division is designated No. 1, comprising the following districts in order of their latitude north of Sydney:

1, Armidale; 2, Bellinger; 3, Inverell; 4, Glen Innes; 5, South Grafton; 6, Grafton; 7, Maclean; 8, Woodburn; 9, Tenterfield; 10, Casino; 11, Lismore; 12, Tweed.

Armidale.—This district comprises the greater part of the southeastern portion of the table-land of New England, with a length of 607 miles of roads under immediate charge of Mr. S. A. Donnelly; in addition to the mileage mentioned the numerous works and bridges provided for by special grants make up an amount of business which characterizes this as one of the most important districts. The springing up of a township at Hillgrove mines, with a population of over 2,000, gave rise to the necessity for an entirely new road, on which heavy traffic had to be provided for and demanded a large share of the superintendent's time and attention; at the same place a problem presented itself as to the best means to provide access to the various workings down the Hillgrove gorge, which has a precipitous scarp extending to a depth of 1,600 feet; this has been solved by the laying out of a zigzag track some 2 miles in length, designed by Mr. Stilwell; a tender for its construction was accepted, but the contractor failed to take it up and fresh tenders have been ordered. Heavy traffic has also developed in connection with the railway stations at Uralla, Black Mountain, and Guyra, from each of which centers new roads radiate and are likely to become of rapidly increasing importance with the settlement of population on the rich basaltic country in the neighborhood of each of these stations. The road from Guyra to Tingha is becoming one of special importance as a route to the tin mines and has to carry very heavy traffic over a surface which presents long stretches of black basaltic soil, and porphyritic slopes of specially treacherous nature apt to become quagmire after any continuous wet weather, and only to be remedied by the most thorough construction. A great deal of good work has already been done on this road, but the expense of construction has necessarily been so heavy that the requirements of traffic are yet a long way from being provided for and occasional interruptions are only to be expected.

Easterly from Guyra a road suddenly assumed importance as the route to the mines at Kookrabooka and Bearhill.

Bellinger.—Here a set of conditions entirely different to the foregoing present themselves. The Bellinger and Nambucca rivers branching off near the coast, are crossed by ferries, those at Raleigh, South Arm, and Nambucca being of considerable width. There are other ferries higher up the river, namely, at Fernmount on the main arm of the Bellinger and at Congarini on the Nambucca. All these ferries are provided with large-sized punts worked by wire-rope gearing, which seem to thoroughly meet the requirements. The various branches of these rivers extend into rich brush land which has been brought under cultivation. The back country is ridgy and broken, but there are numerous pockets of brush land taken up for cultivation, and it has been necessary to connect these with various centers by roads for the most part in side cutting with numerous bridges and culverts. The grading and sectioning of these roads have taken up much time and called for the services of officers of special training and experience. The most important work in hand lately has been the ascent of the table land known as the Dorrigo Road (this is a rise of some 2,000 feet) by exceptionally heavy rock side cutting, the scarp being so precipitous in places

that cascades have threatened the stability of the roadway, and it has been necessary to control them by intercepting channels, leading into the more defined water courses which are provided with culverts. The works on this road are well advanced. The public are very impatient to have it opened, as it will give access to a large extent of rich land only needing this road to induce a population to settle on it.

North from the Bellinger much work has been done in opening up the road to Coff's Harbor, all through brush land, which has been taken up for settlement.

At Coff's Harbor the new jetty, now in course of construction, has given rise to the necessity for a new road about 1½ miles in length, to connect it with the through road between the Bellinger and the Clarence. This road is now well advanced, and will be ready before the jetty is finished. Between Coff's Harbor and Corindi has hitherto been in the Bellinger district, and has demanded a large share of attention; but this together with the road from Moonee to Sharpe's has now been transferred to the South Grafton district. Another important work in hand is the opening up of the road from Boat Harbor via Spickett's Creek to the Nambucca, which will greatly shorten the mail route, and afford direct communication between principal centers of population on the two rivers. There are heavy works on this road in crossing the mountainous divide between the rivers; the connection will probably be available for wheel traffic in a few months. Mr. Leith has pushed on these works energetically since he took charge.

Inverell.—This district has been under the charge of Mr. C. W. Jenkins since 15th October, between which time and the end of the year he reported seventeen contracts completed, seventeen others put in hand.

An exceedingly heavy traffic has to be dealt with on the main road from Inverell to Glen Innes all the way through black basaltic soil, every yard of which has to be metaled; the greater part of it has already been constructed, but being new work, it was terribly cut up during the late wet season, and has required much attention to put it in order again. There is a great sameness as regards the roads in this district, which are for the most part through rich basaltic soil, and consequently expensive to construct.

Glen Innes.—This district, in charge of Mr. Miller, is one in which black soil predominates, and metal construction is much in demand. From Glen Innes toward Grafton is one of the great mail routes of the colony, there being a daily mail between New England and the Clarence via the Newton Boyd road. Metaling is being carried on to a large extent. A great deal of construction has also been carried out on the road from Glen Innes to Red Range and Kings gate, where an agricultural population has settled; one of the principal works on this road is the bridge over the Mann River now nearing completion. Since the opening of the railway the road from Emmaville through Tent Hill to Deepwater has assumed great importance as being the principal traffic route from the rail at Deepwater to the tin mines on Vegetable Creek, and is one of the roads to be provided for from special general vote.

South Grafton.—This newly formed district was only taken up by Mr. Everett at the end of the year, and he has hardly had time to make himself acquainted with it. He has, however, found that the work before him is so onerous that he is unable to devote the necessary time to the exploration and grading for extension of roads in the Upper Orara, which is of the most urgent importance, having been so long awaiting the services of a competent man.

Mr. Everett's camp is now in that locality, and a surveyor has been sent to take up the work.

Coff's Harbor will be the outlet for this country as soon as the jetty is completed, and it is very necessary that these roads should be opened up in time.

Grafton.—The Newton Boyd road remains in Mr. Ranken's charge, and he has in hand the road to the Chandlers Creek gold field, which is heavy mountain cutting. Much the same description of work demands attention, and has been standing over a considerable time for some one at liberty to devote their time to it. The most

important work in hand is the Alumny Creek bridge, an iron structure with brick abutments, the contract for which has been recently let. At Carr's Creek some fascine work has been successfully carried out, where extensive slips have taken place. Another similar work is in progress on the river bank at McLachlan's, near Ulmarra, and is reported to be successful.

The steam ferry at Grafton and ferries at Ulmarra, Southampton, and Eatonswill are attached to this road district. There has been a certain amount of loss of time in transferring newly defined roads and works in hand to the lately formed South Grafton district, but the reorganization is now fairly well established, and Grafton requirements will receive the attention which their importance demands.

Maclean.—This district, which is in charge of Mr. F. G. Hurley, takes in the alluvial delta of the Clarence, a portion of the road Lawrence to Tenterfield, and Harwood to Woodburn, also the steam ferry at Harwood and hand ferries at North Arm, South Arm, Brushgrove, Bluff Point, Maclean, and Oyster Channel. Many of the roads in this district are over swamps and have consequently to be embanked. There are numerous timber bridges which require constant attention on account of the ravages of white ants.

Woodburn.—This district, lately cut off from Lismore, and now in charge of Mr. Crummer takes in the lower Richmond, and a strip along the coast as far as Byron Bay; here swamps have to be contended with on the low lands, and all else is the dense brush, which is rapidly disappearing with the advance of settlement.

There is an ever increasing demand for new roads, and the local officer has no light task in reporting on the various applications and setting out works in cases where funds have been provided. The brush hook and the level have to precede expenditure in nearly every instance, and the work of this district is consequently not to be judged either by the mileage or the amount of grants; and, though lowest on the list in both these respects, it is not by any means an unimportant one.

Tenterfield.—This district is in Mr. Williamson's charge; there are not so many roads as in some of the other large districts, but long distances have to be covered, and the traveling is more than average. Some of the works as at Acacia Creek and Rivertree are at a considerable distance from headquarters.

One of the most important works carried out lately is the descent of the tableland, between Undercliffe and Rivertree, where a road has been constructed with easy gradients, at an exceptionally small cost for such an undertaking.

The road from Tenterfield to Tabulam and Casino has assumed special importance since the opening of the railway, as it is the mail route to the Richmond river district and the Fairfield mines. There are a great many bridges in this district, many of them rather old, and needing careful looking after.

Casino—Is in Mr. Gracie's charge. It is one of the older districts, from which, in succession, the Tweed, Lismore, and Woodburn, have been cut off. There are many important works already carried out which have to be maintained, and lately there has been a great extension of settlement due to the resumption of leasehold areas, which will necessitate new roads, and the more thorough construction of these already opened. The richness of the land and extent of settlement both necessitate and justify a large expenditure in road construction.

Since the opening of the railway to Tenterfield, the mails formerly sent by sea, either by the direct boats, or those trading to the Clarence, are now forwarded by rail and coach, via Tabulan and Casino. In anticipation of such change, a direct road has been opened up, and a great deal of work has been done on it; but it passes over a considerable extent of black soil, and the construction is consequently expensive. Provision for this does not appear on the appended list, as the amount has not yet been determined; it however is noted as one of the roads to be supplemented from the general vote.

Lismore district—Is in Mr. Allman's charge. The town of Lismore is the shipping port for a surrounding country, all of which is of the richest and most fertile descrip-

tion, and will for some time be the terminus of a new railway system. The development of sugar growing and extension of the dairying industry have given rise to the demand for a multiplicity of roads which might appear out of proportion to the size of the district; there can, however, be no question as to the necessity for their construction or the expediency of incurring the expense of so doing. There are numerous and important bridges in this district; some of these still in hand, or about to be commenced. It would unduly prolong this report to allude to these in detail.

The Tweed district—Is now in Mr. Scott's charge, but till recently has been under Mr. Morton, of whose services in connection with the district I can speak in the highest terms.

The district includes the watersheds of the Tweed and Brunswick, with the network of roads having their terminus at Byron Bay, where a jetty has been constructed and a shipping port established. The whole of this country is of exceptional fertility, and the difficulties of road construction are of no ordinary description.

To review the works already constructed, or to sketch those provided for, would involve so much detail that it appears to me it would now be out of place.

Bridge repairs.—The abundance and excellence of the timbers in these districts made timber bridge construction the rule, though some fine iron and composite structures have been erected. The climate is, however, unfavorable to their longevity, dry rot and white ant being very destructive; the white ant even attacks the punts, which are saturated with tar and always in water.

Repairing parties, under experienced, practical foremen, I find to be the most satisfactory way of dealing with these repairs, all material being supplied by contract.

Road districts and appropriations, 1891, *No.* 1 *division.*

Officer.	District.	No. of roads.	Mileage.	Amount.
Mr. Donnelly	Armidale	30	607	11,486
Mr. Leith	Bellinger	16	252	7,165
Mr. Jenkins	Inverell	16	401	14,442
Mr. Miller	Glen Innes	17	369	8,790
Mr. Everett	South Grafton	12	260	9,807
Mr. Ranken	Grafton	8	204	7,485
Mr. Hurley	Maclean	11	154	4,980
Mr. Crummer	Woodburn	16	129	5,235
Mr. Williamson	Tenterfield	14	390	8,870
Mr. Gracie	Casino	13	291	9,125
Mr. Allman	Lismore	41	321	12,510
Mr. Scott	Tweed	19	209	12,970
Total		213	3,587	112,865

NEWCASTLE.

REPORT BY COMMERCIAL AGENT BAGGS.

A report on the streets and roadways of this immediate district—and that is all the territory covered by this report—will hardly be instructive or of advantage, except comparatively.

The streets of the large towns and cities, ranging in population from 3,000 to 60,000 inhabitants, are invariably macadamized, as are also the country roads wherever an effort has been made to improve their original condition.

These city or town streets are formed by loosening the surface soil, spreading on 4 inches of sandstone ballast, then 2½ inches of blue metal, over which is spread a thin layer of sandy gravel. This is the ordinary

formation; but it makes a rough and uneven surface and is quickly cut in holes. On the principal thoroughfares the layer of blue metal is dipped in pitch and a thin coating of pitch over the top of this. This composition makes a good, smooth, hard road; but it needs constant repairing under heavy travel.

Owing to the want of courtesy shown by the Newcastle town clerk I am unable to give the cost of the original formation or of the repair of the city streets.

Owing, however, to the kindness of Mr. W. S. Wells, government engineer in charge of the roads and bridges of this district, exclusive of towns, I am enabled to furnish the following information:

The country roads in this (Newcastle) district (which extends about 50 miles to the south and about 10 miles to the north of this city along the coast and from the coast line inland a maximum distance of 60 miles and an average distance of 35 miles), are partly under the control of government engineers and partly under the control of road trusts. These road trusts are appointed by the government to expend the annual appropriations on the numerous byroads, which are only of local importance to farmers and pastoralists.

I append a list of roads under both, which shows the number of miles of different classes of roads cleared, formed, drained, and metaled up to date, also number of bridges and culverts erected.

Road in charge of engineers	miles	157
Road in charge of trustees	do	248
Road, metaled, graveled, and ballasted	do	70
Road formed	do	96½
Road cleared and partly drained	do	123
Mountain passes and cuttings	do	38
Bridges in district	number	25
Culverts and pipe drains	do	238

The following are the average prices paid for different classes of work in this district:

Clearing 66 feet wide, grubbed to 18 inches, at $3.90 per chain.

Ordinary formation, 30 feet wide, at $4.87 per chain.

Two and one-half inches blue metal spread 18 feet wide, at $2.42 per cubic yard.

Four inches sandstone ballast 18 feet wide, at $1.21 per cubic yard.

Side drains, average depth 2 feet in soil, at $2.42 per chain.

Mountain cuttings, 20 feet wide, from $15 to $100 per chain.

Owing to the fact that this country is as yet so thinly settled, the science of road-building has not reached that degree of perfection which would be of service to an older and more thickly populated community.

The greater portion of the roads are simply wagon tracks through the bush, absolutely impassable in wet weather. Wherever the travel warrants it, however, a good road is formed on the lines above laid down. Between town and town the roads are superior to the majority

of country roads in the United States, but once off the main road their superiority vanishes.

GEORGE T. BAGGS,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Newcastle, New South Wales, May 20, 1891.

FIJI.

REPORT BY COMMERCIAL AGENT ST. JOHN, OF LEVUKA.

Practically speaking, there are no roads in this colony that deserve the name.

Each magisterial district is at present making a dirt road by cutting two parallel ditches and throwing the dirt from them between the two, more to employ prison labor than to build roads that will be used for traffic or pleasure.

The main streets of both Suva and Levuka are made by prison labor of broken coral washed up by the sea, which is a very good material for the purpose, but it is not very lasting.

The traffic of the islands is all done by water; consequently roads are not required.

From inquiry I learn that there is not 50 miles of road in this colony.

Carriages or wagons are not used, except by a very few, in the towns of Suva and Levuka.

ANDREWS A. ST. JOHN,
Commercial Agent.

UNITED STATES COMMERCIAL AGENCY,
Levuka, February 16, 1891.

SUPPLEMENT.

SHEFFIELD.*

REPORT BY CONSUL FOLSOM.

CITY STREETS.

The material used for streets where the traffic is very heavy is granite; for medium traffic gritstone sets and wood blocks; and for very light traffic "tar macadam," *i. e.*, broken granite or limestone mixed with boiling pitch and tar.

Granite.—This is obtained from Leicestershire, Cumberland, and Dalbeattie in Scotland, and costs from 20*s.* 6*d.* ($4.99) to 24*s.* 6*d.* ($5.96) per ton. It is used in the form of sets, measuring 6 by 4, 6 by 3, 5 by 4, 5 by 3 inches and 4-inch cubes, the first two sizes being used for the heaviest traffic. The sets are laid on a bed of concrete formed of broken stone and sand, mixed either with Portland cement or hydraulic lias lime, and laid from 6 to 9 inches thick, according to the nature of the traffic. On the top of the concrete is spread a layer of fine shingle on which the sets are bedded; the joints are then partially filled with one-fourth-inch shingle, and filled up flush with hot asphalt (boiling pitch and tar). Value when laid, including concrete foundation, 13*s.* 6*d.* ($3.28) per superficial yard.

Gritstone sets.—These are obtained from quarries in the neighborhood and district. They are 10 inches deep and vary from about 6 to 10 inches wide. They cost from 15*s.* ($3.65) to 16*s.* ($3.89) per ton. No concrete foundation is used for this pavement, the sets being simply bedded on a layer of shingle and well beaten into place with a heavy "beetle." They are then grouted in the same way as the granite sets. Value when laid about 10*s.* ($2.43) per superficial yard.

Wood paving.—This consists of blocks of red deal 6 inches deep, 3 inches wide, and 9 inches long. Most of the wood paving in Sheffield has been put down in its natural state, but in the last lot the blocks were creosoted. The price of the blocks is about $1\frac{1}{4}d.$ ($2\frac{1}{2}$ cents) each. A concrete foundation is formed similar to that described for granite paving, and over this a layer of sand is spread, on which the blocks are bedded. The end joints butt up against each other, but the side joints are kept the proper distance apart by means of three iron studs driven

* This report was received too late for insertion in its proper place.

into one of the sides of the block, making the joint three-eighths of an inch wide. The paving is then grouted up solid with boiling pitch and tar, or with liquid cement and sand. The latter method is now generally adopted. Value when laid, 12*s.* 6*d.* ($3.04) per superficial yard, including concrete foundation.

Tar macadam.—Very little of this form of paving is used near the center of the town. It consists of either furnace slag, limestone, or granite broken to a $1\frac{3}{4}$ or 2 inch gauge and mixed with boiling pitch and tar. It is laid on a foundation course of flat rubble stone set on edge. This foundation is well rolled with a heavy steam roller (10 tons) and the macadam is then spread over the pitching to such a thickness that after being rolled with the steam roller it will be 4 inches thick. A thin coating of tarred shingle or granite chippings about one-half-inch gauge is then spread on the surface which is again rolled. The rubble pitching costs from 1*s.* (24 cents) to 1*s.* 6*d.* (36 cents) per square yard. Slag tar macadam costs 2*s.* 3*d.* (55 cents) per square yard; limestone costs 2*s.* 6*d.* (61 cents) per square yard, and the granite costs 3*s.* (73 cents) per square yard.

COUNTRY ROADS OR HIGHWAYS.

These are all macadamized. A foundation course is laid as described for the tar macadam. The macadam consists chiefly of limestone which is obtained from quarries in North Derbyshire and conveyed direct on to the roads in carts. It costs about 7*s.* ($1.70) per cubic yard including carting and breaking, equal to about 2*s.* 9*d.* (67 cents) per superficial yard of finished roadway. Furnace slag is also used, and is obtained from the iron works and blast furnaces in the neighborhood. It is delivered at the railway stations at 3*s.* (73 cents) per ton, breaking 2*s.* 1*d.* (51 cents) per ton extra, finished 1*s.* 6*d.* (36 cents) per superficial yard. Granite macadam is also used in suburban roads. It comes chiefly from Leicestershire and costs, delivered at the stations, 9*s.* 9*d.* ($2.37) to 10*s.* 6*d.* ($2.55) per ton broken. Finished roadway 2*s.* 3*d.* (55 cents) per superficial yard.

On a few crossroads and country lanes gannister is used, but only where the traffic is exceedingly light. Costs about 1*s.* (24 cents) per superficial yards.

The macadam of whatever material it may be is spread over the road to the proper contour and covered with a layer of small limestone chips, or, in the more remote roads, with clean roads sweepings. It is then watered and rolled either with the steam roller or a heavy two-horse roller.

GENERAL.

The first cost of public roads, and also the cost of maintenance is paid out of the public rates, the expense being thus borne by the whole of the rate-payers. Where the road is a private one, having been laid out and made by individual owners, then the expense of paving, etc.,

done by the corporation prior to taking it over as a public road, is divided amongst the property owners on each side of the road in proportion to the length of their respective frontages.

A well-made road undoubtedly enhances the value of the adjoining land or property, although it is difficult to say to what extent. In the case of cottage property adjoining a private street the effect of making good the street and "dedicating" it to the public frequently is to raise the rentals.

I am indebted to Charles F. Wike, esq., borough surveyor, Sheffield, for the foregoing facts in relation to the construction of pavements and roadways in and about Sheffield.

The following paper by Mr. Edgar S. Saunders, C. E., assistant borough surveyor, Sheffield, has been kindly furnished me by him, with drawings illustrating the manner in which the best pavements and roads are constructed:

PAVEMENTS AND ROADWAYS.

Before deciding of what material a roadway is to be made there must be considered the class of trade of the town, whether a manufacturing, agricultural, or seaside town, etc., and also (and more important than the foregoing), the gradient of the road or street in question. A good roadway should be:

(1) Durable and requiring little repairing.

(2) Safe with a minimum of traction, and yet with sufficient foothold for horses, and with as little possible jolting to the traffic.

(3) Laid to such a cross-section as will throw off the rain water at once.

(4) Easy to cleanse, nonabsorbent of moisture, and make a minimum of mud and dust.

(5) And it must, above all things, have a good and firm foundation; for it must not be forgotten that it is the foundation that carries the weight, and that the superincumbent pavement is really only the means of transferring the weight of the traffic to these foundations, and that, however durable the pavement may be, it is bound to require renewal, whereas the foundations should be permanent.

The wear of the surface of a road is generally estimated to be due to the action of the horses' feet to the extent of two-thirds of the total wear, the remaining one-third being due to atmospheric and other causes.

It is impossible to cleanse a roadway too much; not only does it add to the life of the sets (of whatever material they may be), but it is also a great boon to the horses which have to traverse them, the difference in traction between a paved roadway well swept and in good order, and one covered with mud, being sometimes as much as 50 per cent.

Considering safety in traveling only, it is stated that a horse will travel the furthest without falling, on gritstone sets, wood pavement ranking second, asphalt (natural) third, and granite last of all; but it must not be therefore necessarily assumed that gritstone has a superiority over wood or the latter over granite, since, as mentioned at first, there has to be considered the gradient of the street and therefore the foothold required.

A most important consideration is to give a proper contour to the carriage way. This is mainly dependent on the longitudinal gradient of the road, or street, in question, it being necessary that a more convex contour should be given to a level, or flat, street than to one with a sharp incline. It is also dependent upon the material used for paving, more camber being needed for gritstone than granite; asphalt pavement requires the least, as there is a minimum amount of friction; then comes wood, next

granite, and lastly gritstone sets. (See Appendices B C D and E.) It is therefore impossible to give a fixed rule for this, but it may be safely assumed that the variation should extend from about 1 in 30 to about 1 in 40, according to the gradient of the road and the material used.

It has been a considerably discussed question as to what should be the actual form of the cross-section of the roadway, whether circular, parabolic, or two straight lines connected tangentially by means of a central curve, and probably in the majority of cases it will be found that the latter is the easiest for average traffic, but if adopted, the two side lines should not, in practice, be perfectly straight, but should have a slight camber given to them, as otherwise there might be a tendency in the sides of the carriage way to wear hollow. (See Appendices B, C, D, and E.)

The usual materials at the paver's disposal, are: (1) Granite, (2) wood, (3) asphalt, (4) gritstone. The last, though not in very frequent use, is, if of proper grit, a valuable material, particularly in towns built in hilly countries where granite or wood would be dangerous to traffic, and where the traffic is not too great.

It is now proposed to describe the manner of utilizing the foregoing materials as pavements for the carriage ways of large towns.

Granite sets.—Granite sets well laid undoubtedly form the most durable of pavements, being hard, cleanly, lasting, nonabsorbent, and making little dirt or dust, their only objection being that they are somewhat noisy and (in certain conditions of the atmosphere) slippery, although this depends to a great extent upon the kind of granite used. Whatever the class of granite, it is essential that it be well squared and dressed before it is laid. The sizes of the sets in most general use are: 7 by 4 inches, 7 by 3 inches, 6 by 4 inches, 6 by 3 inches, 5 by 3 inches, and 4-inch cubes.

The 5 by 3 inch and the 4-inch cubes should not be used where the traffic is very heavy, but are suitable for streets having a medium tonnage passing over them. They are, of course, lighter, and therefore easier to handle than the deeper and broader sets, and so a pavement constructed with them is laid rather more rapidly, which may be sometimes advantageous. The 6 by 4 inch and the 6 by 3 inch are the sizes of sets most frequently employed. The former, however, should not be used on a street having much incline, as being 1 inch wider than the 6 by 3 inch sets, they do not afford so good a foothold for horses. The sets should be dressed truly square, with the sides and ends perpendicular to the face and bed, so that the areas of the two latter are equal. This is most important, as not only does it insure stability and firmness to the pavement, each set having its utmost area of base, but also, if the pavement requires repairing and resetting in the course of time, it allows the sets to be reversed, *i. e.*, the bed may be turned uppermost so as to form the face, which is an economical practice well worth consideration.

If the sides be not truly square to the face but incline inwards, then the base is less in area than the face, and the condition of the set is one of perpetual unstable equilibrium; nor can the sets be used over again as suggested above, as the top joints could not then be made good since they would be wider than the bottom ones; for this reason also the sets must not incline outwards from the face to the bed. Care must also be taken to reject, or to have redressed, any sets with much belly on their sides, that is to say, sets whose sides instead of being plane surfaces are more or less spherical. It is sometimes impossible to altogether do away with this objectionable feature on account of the difficulty of working some of the granites, but, as far as possible, it ought not to exist, as it is impossible to grout satisfactorily such a joint as will be found by the contact of one set with another one of which is "bellied" on the side of contact; it also spoils the regularity of the lines of the joint of the pavement, which should be exactly parallel to each other, and strictly at right angles to the curb line of the road or street.

With regard to the face an exact uniformity of surface is not a necessity; indeed it is requisite that there should be a certain amount of roughness to obviate slipperiness, but large or unsightly excrescences should not be allowed.

In resetting a street already paved with granite the old sets must be taken up and carefully squared and dressed in the manner above described, the sets being reversed, *i. e.*, the old bed made the new face if the original quality of dressing will allow it; if not, a new face must be made which will, of course, reduce the depth.

The ends of the sets as before stated should always be dressed so as to be perpendicular to the face, and to be truly planed.

In taking out the excavation preparatory to paving a road with granite sets, and which road—supposing, for an instance—has hitherto not been formed with this material, the formation level should be made at a depth sufficient to receive the depth of the sets proposed to be used, together with about 1 inch for bedding material, and about 9 inches for concrete, which latter thickness is, as a rule, the most useful one for the foundation course. Thus, suppose the size of the sets to be used is 6 by 3 inches, then the depth of the excavation will be:

	Inches.
Depth of sets	6
Bedding material	1
Concrete foundation	9
Total	16

If, however, the ground at this depth be found to be boggy, soft, or at all unreliable, then a further depth should be excavated, and additional concrete put in; and conversely, if, as is sometimes the case, in old macadamized roads, which consist, by means of numerous old coverings, of great thickness of metal, it be found that there is a good foundation before getting to the depth of the 9 inches for concrete, then a less thickness for the latter material will suffice, thereby effecting economy with equal strength. In any case the formation level should correspond in camber with the proposed finished surface of the road, so as to insure uniformity of thickness of foundation course.

The binding element of the concrete must be either hydraulic lias lime or Portland cement, the former being the most generally used, though in several towns the latter material is almost exclusively used for this purpose. Given good materials, the following are suitable proportions:

LIME CONCRETE.

	Measures.
Broken stone	3½
Clean sand	1½
Hydraulic lias lime	1

CEMENT CONCRETE.

Broken stone	3½
Clean sand	2½
Portland cement	1

The stone should be clean, hard, and angular in shape, the latter qualification being very necessary, as stones having a rounded surface will not bond well together so as to form a homogeneous mass; care must also be taken to exclude all clay dirt or other foreign material which would tend to prevent thorough cohesion.

The sand must be clean and sharp and, as a rule, good river sand is preferable to all other; it must also, similarly to broken stone, be free from all dirt of any kind. In towns in which there are large iron works "slag" dust has been used for concrete in place of sand, but though more economical in some cases (on account of being local), and though it forms a good enough material for the purpose if clean, its use can not be generally recommended on account of dirt being very frequently intermixed. The lime should be hydraulic blue lias—lime from the hardest and lowest beds of the lias formation.

Should cement be used it must be well burned Portland cement of the best quality, free from all dirt, or other foreign substance, and slow setting with a gray color when gauged and air dried. It should be of not less than 114 pounds weight to the bushel, and must be sufficiently fine so that a portion being sifted through a wire sieve of 2,500 meshes to the square inch there must not be left a residue of more than 10 per cent. in weight.

Briquettes of neat cement should be made in the proportion of 7 ounces of water to 40 ounces of cement and should remain one day in the air, and then be placed for 6 days in water, after the expiration of which time they must be tested in a proper cement testing machine, and should sustain a tensile strain of 350 pounds to the square inch.

The concrete must be mixed upon a low movable platform capable of being shifted along as the work proceeds.

The three materials, stone, sand, and lime, or cement, as the case may be, should be measured separately, the stone then being placed by itself on the platform and the sand and lime (or cement) thoroughly incorporated with each other. The two latter must then be placed over the broken stone, and the whole mass must be completely turned over twice, so that the whole of the materials may be thoroughly intermixed. Water should then be added from a watering can provided with a rose, and the materials well turned over again for a third time; the concrete must then be immediately shoveled up into barrows, and wheeled away on to the formation surface, giving by the action of loading the barrows another turn over. Too much importance can not be attached to the necessity of thorough and complete incorporation of the materials, and as this can only be obtained by means of careful and repeated turnings over it is necessary that this be done in a most careful and complete manner. Concrete is, after all, but like masonry—stones and mortar—and just as the blocks of stone of the latter should be surrounded on all their joints with the mortar, so also the broken stone in concrete must, each individually, be surrounded with a perfect coating of the lime, or cement and sand. Another point to carefully note is the quantity of water used. The workman is sometimes to blame in this particular, as he often adds more water than is sufficient to release the chemical action of the lime or cement, as the case may be. Too much water greatly weakens the strength of the concrete and only so much should be used as will completely wet, but not drench, the material on the platform. The acting of the turning over, loading into the barrows, placing in situ, and ramming will, if properly done, completely wet the whole of the material, though possibly it might seem too dry immediately after the watering.

Before the concrete is placed in position levels must be fixed for it so as to insure uniformity of thickness and camber. These levels should consist of iron pegs not less than 18 inches long and placed longitudinally at short distances, the number across the road depending on the width of the carriage way; the tops of these pegs are to be carefully boned into the required gradient, and also to the proper camber of the transverse section (it must not be forgotten that the formation surface should have been first formed to the proper contour); 9 inches upwards from the ground should then be marked on the pegs, if the concrete is to be of that thickness, and either that portion or the remaining top inches is to be chalked or painted over so that the finished surface of the concrete may be clearly defined. This setting out of the levels requires careful attention, and must be well looked after. The iron pegs being properly fixed, and the concrete being thoroughly mixed, as before described, and loaded into the barrows, it must be wheeled from the mixing platform, deposited in position, and be well rammed with heavy wooden rammers, until its thickness is uniform with the chalked pegs. Thorough ramming is very essential, not only to consolidate the concrete but also to work up a smooth finished surface. The concrete must then be allowed to thorougly set before any further steps are taken, which length of time will depend somewhat upon the quality of the lime and cement.

The next process is to cover the concrete with bedding material for the sets. This may consist of either coarse sand or very fine gravel, and in towns where there are works, furnace ashes form a very suitable and economical material. Whatever is used it should be spread over the concrete to a depth of about 1 inch, so that the more or less irregular beds of the sets may have a firm seat over the whole of their area. The sets are then to be laid in rows with their lengths at right angles to the direction of the street. They must break joint properly, with as much overlap as possible, and must be well and solidly rammed. The channels, next to the curb, may be formed of two or more rows of sets placed at right angles to the other sets, *i. e.*, parallel in their length to the direction of the street, but a better channel is made by using slabs of granite 15 inches wide and of a depth equal to the sets used, the joints being truly square, and the surface dressed off to a plane surface. This latter plan enables the rain water to flow much quicker to the gullies, particularly in a flat street, there being less friction than if sets are used, being less joints, and a more even surface. In any case the channels should be laid about 4 inches below the level of the curb, and one-quarter inch below the sets. (See Appendix B.)

Should the gradient of the road be steep it is a good plan to lay a "wheeler" course, that is to say, a row of granite slabs, similar to those forming the channels, should be laid on the left-hand side of the road going up hill, and at a distance apart from the channel, center to center, equal to the average gauge of the wheels of the traffic which will most frequently use the road. These are of very great service to heavy traffic on a steep gradient, acting, in fact, as tram lines, affording as they do the minimum of traction to the wheels of the vehicles, while the sets between them afford a good foothold for the horses.

The sets being laid they have now to be grouted. Clean gravel, small stones, or fine slag (which forms a most suitable material if cheaply obtainable), not exceeding a quarter-inch gauge, must be spread over the top of the sets and be repeatedly swept over the surface until the joints are filled to rather more than half their depth, and, if necessary, a "cramming" iron must be used to wedge the shingle firmly into the joints, care being taken not to disturb their true line. The joints must then be grouted, thoroughly flush, with boiling pitch and tar, and it must be understood that this grouting should be really thorough and complete.

It is impossible to give the exact proportions for the mixing of the pitch and tar necessary for the final grouting, as the latter varies so much in its consistency; it is generally obtained from the gas works of the town, and should be as pure as possible. The pitch most suitable for use is that known as "medium hard," and should be of such a nature as to be softened after being immersed 5 minutes in water heated to a temperature of about 60° C. (140° F.). The two materials must be placed in a tar pan and well boiled, one man being constantly employed in turning the mixture over with a ladle, when the boiling point has been reached, and continuing to do so until the contents begin to settle, when, as a rule, it is ready for use; this is necessary to prevent boiling over which might result in the whole panfull catching fire. It must be boiled so that a cake of it when cool and set must be tough and not too brittle, but with a slight and only slight amount of elasticity. If it be too brittle when set the vibrations of the traffic may crack it and loosen it from the sets, which it will not therefore properly cement together; if it be too elastic it will in hot weather work out of the joints and get soft, thereby not giving the necessary support to the stones. Proper grouting is therefore a very important adjunct to good carriage-way paving.

The last operation concludes the work of laying granite pavement, which pavement is, on the whole, probably the most useful, durable, and, in the end, economical pavement that can be adopted for the carriage ways of large cities or towns.

Appendix B at the end of this pamphlet shows a suggested cross section of a roadway paved with granite sets. The footpaths have been added in this and the succeeding appendices, merely in order to complete the transverse section of the whole road. The cross fall of the carriage way, shown in the appendices, is of course not

arbitrary, since, as before explained, this will vary in accordance with the gradient of the street.

Wood pavement.—The advantages of wood pavement are: (1) It is the quietest of all pavements. (2) It gives a minimum of traction, excepting asphalt. (3) It is very clean, as if properly formed it should make no dirt. (4) If a horse fall on it he can, it is said, rise easier than on granite or asphalt.

The objections are: (1) It absorbs moisture to a somewhat great extent. (2) The wood is liable to swell and sometimes forces up the curbs and footway. (3) It can not well be used on a steeper gradient than 1 in 20 at the most.

It is not as durable as granite, and therefore, though not costing quite so much in the first instance, it really is dearer than the latter, as it requires more frequent renewal.

The best wood to use for the purpose is Baltic red timber, or yellow deal; and must be thoroughly sound and well seasoned, especially free from sap, and also from all shakes, knots, or other imperfections. The blocks, which must be cut so as to have the fiber upwards, should be 6 inches deep by 3 inches in width, and 9 inches in length. The blocks are sometimes creosoted, in which case 1 cubic foot of wood should absorb about 8 to 9 pounds of creosote. If the wood used be of really good quality, and be carefully laid with the fiber vertical on a good concrete foundation, such as described for granite paving, and be thoroughly grouted, this class of pavement will wear for a considerable time, its life with average traffic, and with, of course, needful repairs, being about 9 or 10 years. It is especially useful when laid in places where it is necessary to subdue the noise of the traffic, such as in front of a hospital.

With regard to the method of laying it is unnecessary to mention again the concrete foundation, as the method before described for granite pavement applies equally to wood, whether in materials, manner of mixing, or mode of laying. The concrete laid, and having become thoroughly set, a thin covering or bedding of sand should be spread over the surface, and on this the wood blocks, carefully selected, should be set with their lengths at right angles to the curb line, and having their ends in contact.

The setting should not commence close to the channel, as in the case of granite pavement, but about 7 to 9 inches from it, this space being filled up the last thing; this allows for any swelling of the wood, and will help to counteract the pressure against the channels and curbs, and lessen the tendency to force them up. An "expansion" joint is also sometimes left near the curb, but this is very unsightly and is of questionable utility. The side joints, that is to say, the joints running across the street and parallel to the length of the blocks, must be kept apart so as to afford a foothold for the horses. The width of these joints should be about three-eighths of an inch, and they may be obtained either by using laths of this width placed between each row and afterwards removed for the grouting, or, what is better, by means of three iron studs, having square heads three-eighths of an inch thick, and driven home into the sides of the blocks so as to form an equilateral triangle. This latter method has great advantages over the former and is the one most commonly adopted. When the laths are removed for the grouting the blocks are very liable to be more or less shifted from their position on account of the workmen walking over them, and other causes, and always require some adjusting and putting into proper line before the final grouting takes place. and even then it is very difficult to get a truly uniform joint the whole width of the carriage way. By utilizing the iron studs, on the contrary, each block may be at once firmly placed against its longitudinal neighbor, and there is no danger of any movement taking place prior to the grouting. Gravel or shingle three-eighths inches gauge is then sometimes swept over the surface of the pavement so as to partially fill up the joints (in a similar manner described for granite paving), but it is a question whether this should be requisite when the iron studs are used, as these should insure thorough stability and solidity to the block. When

the laths are used it is of course necessary to have the shingle. The grout itself may consist of either Portland cement and sand or pitch and tar, as specified for granite pavement, or may be, and this is probably the best, a combination of both methods.

The pitch and tar, well and properly boiled and of good quality, as before described, should be poured into the joints of the pavement until they are filled to about one-third their depth; this should be allowed to get cool and set, after which a grouting, consisting of Portland cement and clean sharp sand, each of such quality as hereinbefore detailed, and in the proportion of one part of cement to one and a half parts of sand (or even only one part of sand if the cement be at all poor), must be poured in so as to completely fill all the joints flush with the surface of the blocks. The whole surface of the carriage way is then to receive a coating about half an inch thick of fine gravel or small, clean chippings.

The channels should be formed by means of two rows of blocks set with their lengths parallel to the direction of the street, and laid 4 inches below the curb and flush with the main blocks. (See Appendix C.)

Asphalt pavement.—Asphalt pavements are not greatly in use, and it is a material which can not be generally advocated as useful for the pavements of carriage ways of large cities, its great objection being its extreme slipperiness and also the great difficulty of stopping or starting a horse drawing a burden on account of the almost non-existence of a foothold. The chief points in its favor are that it is very noiseless though not so much so as wood; there is very little traction, no shaking or vibration in driving over it; it is very easily cleansed, and is quickly laid. It is, however, impossible to use it where there is anything like a gradient, and also it can not be laid in wet weather.

The asphalt itself consists of carbonate of lime and bitumen, chemically combined in somewhat varying proportions, and should have a fine and uniform grain when broken. For laying carriage ways the limestone should contain about 10 per cent. of bitumen. Asphalt pavement has one particularity peculiar to itself, and thereby differing from all other pavements, and that is that owing to its elastic nature, which is its great feature, and which lasts for a long time, it does not actually begin to wear until it has been laid for a considerable period, although its actual thickness will be reduced.

It is to be laid on a concrete foundation as previously described, and which must, and this is more important in this than in all other kinds of superincumbent pavement, be thoroughly set and perfectly dry, as otherwise the asphalt will be liable to "blow." Cement concrete is better than lime concrete for the foundation of this pavement.

The rock asphalt must be of the purest quality, and be of such chemical analysis as before mentioned; after being broken to small lumps it must be thoroughly pulverized in a proper disintegrator. It should then be heated on plates to such a temperature as may be necessary to wholly get rid of all moisture, this temperature varying according to the nature of the material, but generally about 220° to 270°. It must be immediately and carefully carried to the road in covered vehicles of iron so as to lose as little heat as possible, and to be spread over the surface of the concrete foundation to a depth of 3 inches, which will be reduced, after ramming, to nearly 2 inches. It must then be carefully raked and spread, so as to ensure thorough regularity of depth and evenness of surface, and be well rammed with heated, to prevent sticking, iron, of about 10 pounds weight, the ramming being done lightly at first and heavier afterwards.

When finished the pavement, if properly done, should present a perfectly uniform and pleasing appearance. It must be allowed to cool and become thoroughly consolidated before allowing traffic to pass over it. The slipperiness, its great drawback, may be temporarily remedied by strewing fine shingle or sand over the surface, but this tends to wear it out, as it breaks the skin and lets in the moisture; it also makes the surface muddy and dirty.

The channels should be formed of either granite sets laid in rows about four in number and parallel to the curb line, or with granite slabs 15 inches wide and 6 inches deep, as described hereinbefore. In any case the channels should be laid about half an inch below the level of the asphalt and 4 inches below the curb. On the whole this kind of pavement can not be generally recommended for the paving of towns, being dangerous to traffic and not sufficiently lasting where the traffic is heavy; its advantage being its quietude, easiness of traction, imperviousness to moisture, and the ease with which it is cleansed. (See Appendix D.)

Gritstone sets.—Sets formed of gritstone are used to a large extent in those towns or cities, near which there are suitable quarries. It is a material having many advantages for the pavement of carriage ways, but it can not be said to be durable where there is great traffic, and this is its great drawback, as, of necessity, this means frequent repairing and renewal, which eventually causes it to be classed as an expensive pavement. For roads, where the traffic is moderate, or where the gradient precludes wood and asphalt, and makes even granite dangerous, gritstone sets are very useful and may be adopted with success. They are not slippery, do not present too much traction, afford good foothold to horses, and are speedily laid. This pavement is not so noisy as granite, and is, in the first instance, considerably less expensive (always supposing that the requisite quarries are more or less in the locality) but as a durable, useful, pavement it can not be compared with the latter, nor is it, as stated above, cheaper in the end.

The stone should be from a good gritstone quarry and be composed of a hard, brown, or yellowish brown, grit not too close. Very fine grits should be avoided, as these do not possess the necessary wearing properties.

The sets must be cut so that the grain of the stone is parallel to the length of the set, and at right angles to its width. This is of the utmost importance as sets with their grain cut this way will wear much longer than with the grains parallel to the width of the set, so that in case of two sets being placed side by side in the pavement one cut correctly and the other incorrectly, it would follow that the wrongly cut one would the soonest show wear, and there would be a "puddle hole" in the street. The reason why the wrongly cut sets wear away the quickest is because the grain being parallel to the width of the stone it is in the line of traffic, to which it therefore renders little resistance, and is soon overcome by it. The sets may vary in depth from 8 to 10 inches; the latter being the most useful, and though costing more at first are the most economical, as when they are worn down about 2 inches and have thereby got irregular and into holes, (and it may here be remarked the worst feature of this pavement is that however uniform in quality all the sets may be, and however uniformly and properly cut, it will always, unless the traffic be a very light, wear irregularly which is probably due to the traffic more or less confined to certain lines which will always soon tell on gritstone), the 10-inch sets may be taken up, redressed and squared and then reset, whereas the 8-inch sets are, as a rule, too much worn and knocked about so that they are only worth using for bowlder pavement. The 10-inch sets, being of course heavier than the 8-inch, require more handling and can not be set as quickly as the latter.

Whatever the depth, the width should not be less than 5 nor more than 7 inches, and the length should be from 7 to 10 inches. It is not necessary that the pavement of the street should consist of sets of one width, such as is adopted for granite sets, as a horse can obtain foothold on the stone itself, whereas in granite paving the foot of the horse, if placed on the center of a set, almost invariably slips back until it reaches the joint. For a steep gradient, however, the narrower gritstone sets should be used, the broader ones being kept for flat streets.

The sets must be dressed truly square through their whole depth, so as to insure an area of base equal to that of the face. No excresences on the sides or end joints must be permitted, it being necessary that all the joints should be truly perpendicular to the face and parallel to each other. The face of the sets may be left somewhat rough, as any undue roughness will soon be worn off by the traffic.

This class of sets having—compared with granite or wood—a large area of base, it is not necessary to have a concrete foundation, provided that the ground at the formation level be found to be hard and solid, and provided, also, that the traffic to pass over is not too heavy (and it must be remembered that this pavement is not suitable where the traffic is great). If, however, the ground, or any part thereof, be found to be soft or unreliable further excavation must be made and lias lime concrete filled in, as specified before for the granite paving. On the surface of the foundation, whether natural or concrete, a layer of clean sand or, if cheaply procurable, furnace ashes is to be spread about 1 inch thick, on which the sets are to be laid in lines, with their length at right angles to the direction of the street, and properly coursed in single courses. They must be set with an overlap of at least 3 inches at the joints and, as before mentioned, so that the natural grain of the stone is parallel to its length. Each stone when set should be well and solidly rammed with a heavy "beetle," care being taken to preserve the proper camber.

The sets must then be grouted in a manner similar to that described for granite paving, *i. e.*, one fourth inch gravel, or slag, must be swept over the surface, using a "cramming iron" if necessary until the joints are about half full, after which they must be flushed up solid with boiling pitch and tar as before detailed. The channels may be formed either by simply the prolongation of the rows of sets up to the curb or may consist of gritstone slabs, similar to the granite one mentioned for granite paving; the latter method is probably the best as the slabs offer less resistance to the surface water; they should measure 15 inches wide by 8 to 10 inches deep, and must be set, as in the case of the other pavements, 4 inches below the curb and one-fourth inch below the sets.

In many towns this class of pavement is successfully used, but too much must not be expected from it; it has not the wear and solidity of granite, and can not be used economically where the traffic is very heavy, but for streets with comparative steep gradients and moderate traffic, gritstone sets form a most useful material. (Appendix E shows this class of pavement.)

There has now been described in detail the four materials mentioned at the commencement of this essay, viz, granite, wood, asphalt, and gritstone, but it should be clearly understood that whatever material be adopted the success of a pavement consists in the manner in which the material is dressed, the way it is laid and grouted, and in having a good firm foundation; in other words the points to be considered are: (1) Suitable material of the best quality. (2) Material to be properly "got up" and prepared. (3) The foundation must be thoroughly hard and firm. (4) There must be skillful laying and perfect ramming. (5) The grouting must be of good and suitable composition, and liberally filled into the joints.

The last stipulation does not, of course, apply to asphalt pavement.

The proper construction of crossings at the junction of new streets is of great importance, and is not always an easy undertaking, great care being required to set out the proper levels, which must be strictly adhered to in the laying. The center line of each road must bone through, each central line coinciding in level at the point of intersection, the camber of the main carriage way working flat as the center of the crossroad is reached, so that at that point there will be no camber; this is to be done by keeping up the level of the line of the channels of the main road as the center of the crossroad is approached, which will cause the center of the two roads to be the highest point of the crossing, and also cause the two crossings at the ends of the secondary street to have a suitable camber, so that all the surface water will fall off easily into the proper channels and there will be no jolting or hindrance to the traffic. The crossings at each end of the side street should have a number of lines of granite slabs, sometimes called "plodders," laid parallel to the direction of the main street, and separated from each other by three or four rows of granite sets. The plodders should be 12 inches wide and equal in depth to that of the sets used; they are a great convenience to pedestrian traffic, as they are much easier and more pleasant to walk upon than the sets. (See Appendices F and G).

The sets forming the large crossing may either be laid in the same manner and direction as they are in the main carriage way, that is to say, in regular rows with their lengths at right angles to the line of the street (see Appendix F), or, what is much better, may be placed diagonally (see Appendix G). This latter system affords a good foothold for horses in turning the corners and prevents the danger of slipping, which is very liable to occur when a horse is pulling along the length of the sets. The ends of the diagonal sets, where they abut upon the straight sets, at each of the four sides of the crossing, must be properly cut and leveled off so as to insure a good joint, and where they meet each other at the two center lines they must form a true "herring-bone" joint, which may be either single or double, the former being the most generally adopted. (Appendix G shows the latter.)

The circular channels, connecting the channels of the two streets, are to be truly cut to the proper radius, bone through, and be carefully laid.

The footpaths in Appendices F and G are shown merely to complete the plans of the streets.

For the surface drainage of the carriage way, and also to receive the rain water off the causeway, gullies must be provided. These should be of cast-iron, properly trapped and connected to the sewer with 6-inch glazed stoneware socket pipes, having their joints filled with puddled clay, and a puddle band 5 inches thick around each socket joint. The distance apart of the gullies mey be somewhat greater on a steep road than on a flat one, and if the longitudinal section of the carriage way be a dead level it will be necessary to give an artificial fall in the channel, that is to say, the point in the channels half way between two gullies must be kept higher than the level of the channels at the gullies, but this must be avoided as much as possible as it breaks the uniformity of the cross fall of the road. In all cases, however, thorough surface drainage is necessary, both to lengthen the life of the pavement and to render the traffic, whether vehicular or pedestrian, safe and pleasant. As mentioned at the commencement proper cleansing is also an important adjunct.

Great advances have been made during recent years in the quality and workmanship of the carriage-way pavements of our large towns, and there is no doubt that as "experientia docet," there is to be still further improvement made before the highest point of perfection is gained.

Prices have been purposely omitted in this essay, as the cost of pavements depends so much on the position of the towns, its proximity to granite, or other quarries, the means of transport to it by rail, or canal, that it is impossible to give satisfactorily an idea of its value.

Granite pavement.—As a rule the most suitable granite for paving are syenites, or syenitic granite. The syenite consists of quartz, feldspar, and hornblende, the latter taking the place of mica in the ordinary granite; syenitic granite consists of all the four constituents. They are generally obtained from quarries in Leicestershire, Cumberland, Guernsey, and Jersey; the material from the latter two places is, however, apt to wear slippery. Penmaenmaur stone from North Wales, a kind of trap-rock, is likewise used, and also different granites from Ireland and Scotland, such as (from the last-named country) Aberdeen and Dalbeattie.

Wood pavement.—Beech wood has been employed for wood paving, but is dearer than the red wood, or yellow deal, which should always be carefully cut from sound specimens of the northern pine.

Asphalt pavement.—Instead of the rock asphalt being pulverized and heated, as described in the foregoing paper, it is sometimes mixed with small hard grit and melted down to a liquid state, a small amount of bitumen being added to assist the process. It is then removed from the boiling pans in ladles and poured over the concrete foundations, brought up to a regular surface by rubbers and covered, while soft, with fine shingle. This method, however, is not so good as the compressed pavement.

Gritstone sets.—A great quantity of the gritstone used for paving comes from Yorkshire and Lancashire.

Weights of materials for carriage-way pavements and the areas they will cover.

[A cubic foot of granite weighs 164 to 180 pounds.]

A ton of granite sets—	Sq. yards.
7 by 4 inches will cover about	3
6 by 4 inches will cover about	3⅜
6 by 3 inches will cover about	4
5 by 3 inches will cover about	4¼
4 by 4 inches (cubes) will cover about	5

A cubic foot of red deal weighs about 43 pounds; 1,000 wood blocks 6 by 3 by 9 inches set with three-eighths of an inch cross joint will cover about 22¾ square yards, it taking about 44 blocks to 1 yard.

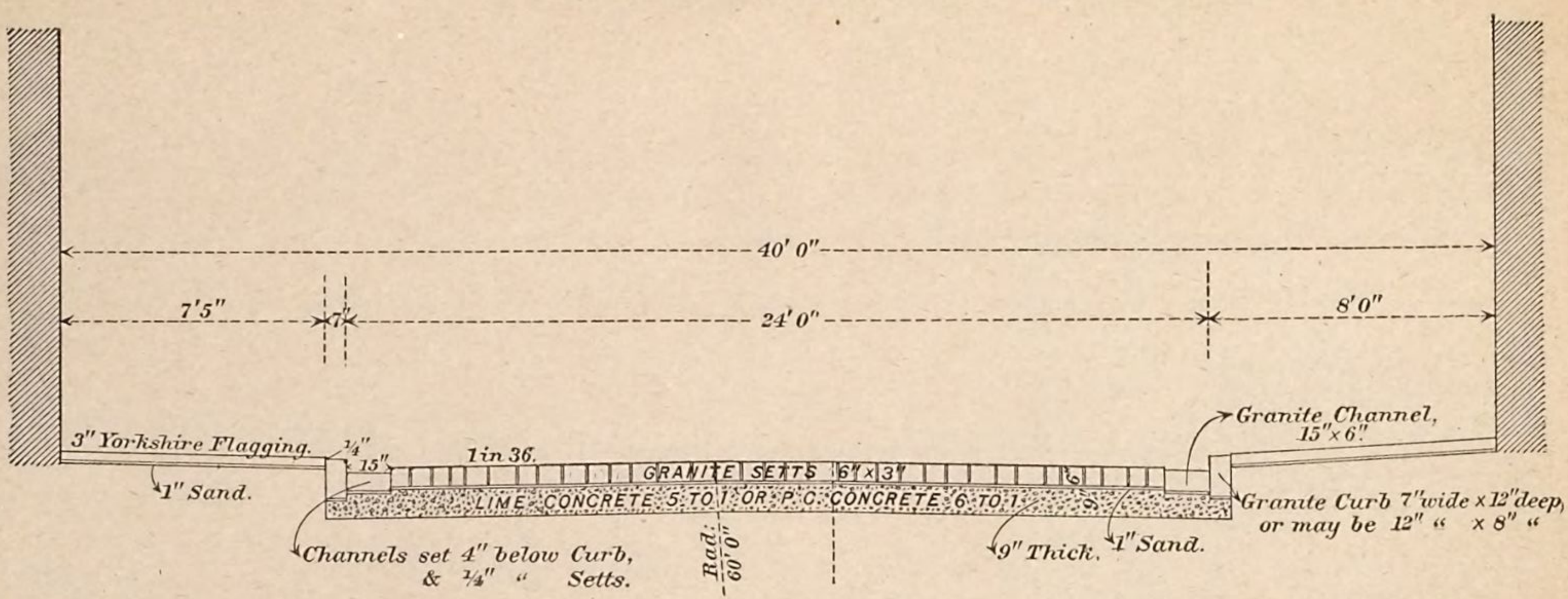
A cubic foot of asphalt weighs about 143½ pounds. A ton of asphalt laid 3 inches thick (before ramming) will cover nearly 7 square yards.

A cubic foot of gritstone weighs 155 to 170 pounds. A ton of gritstone sets, 10 inches deep and about 6 inches wide will cover 2 square yards; 8 inches deep will cover about 2⅜ square yards.

BENJAMIN FOLSOM,
Consul.

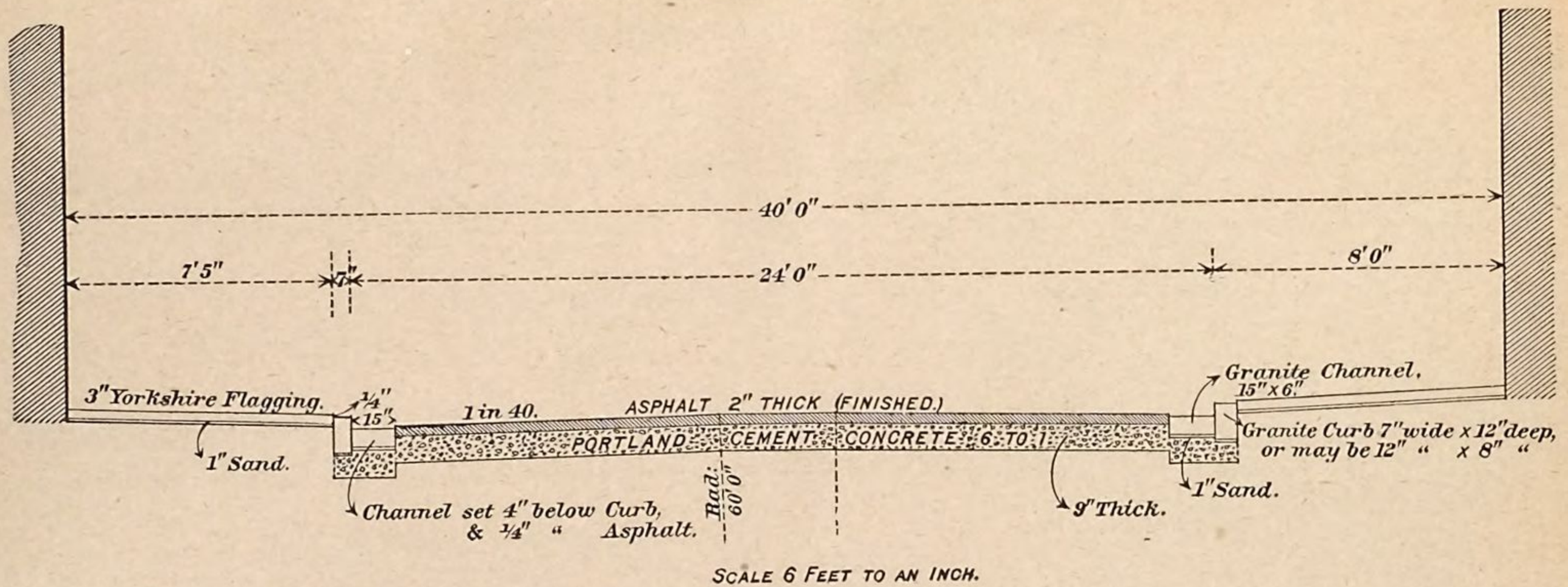
UNITED STATES CONSULATE,
Sheffield, August 10, 1891.

APPENDIX B.—Cross section of a road paved with granite setts.



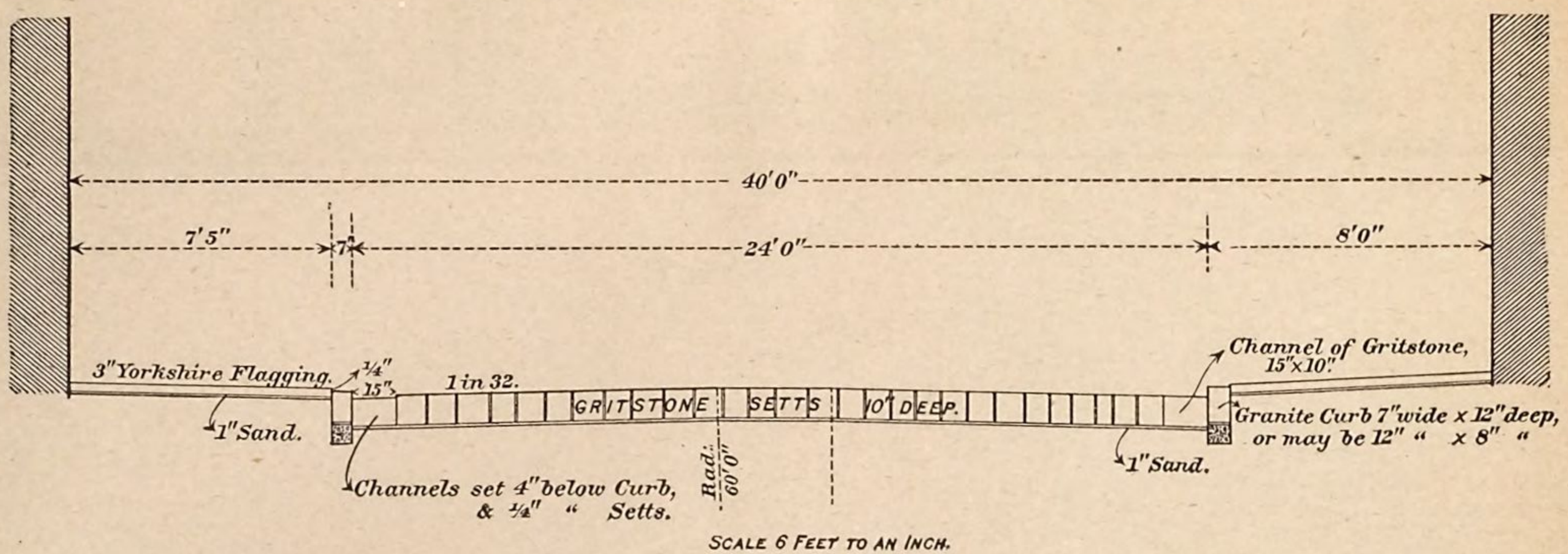
SCALE 6 FEET TO AN INCH.

APPENDIX D.—Cross section of a road paved with asphalt.

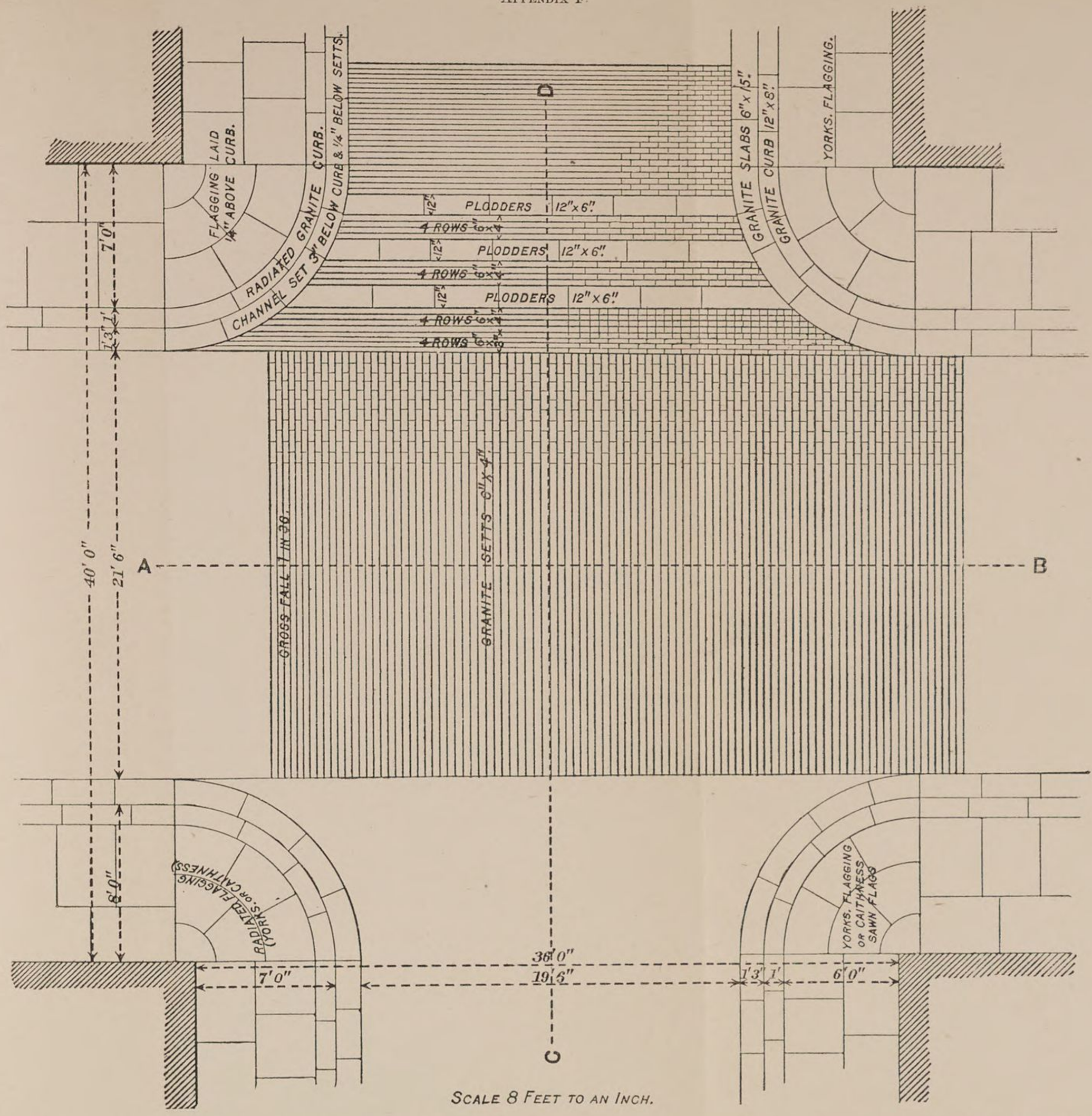


SCALE 6 FEET TO AN INCH.

APPENDIX E.—Cross section of a road paved with gritstone setts.

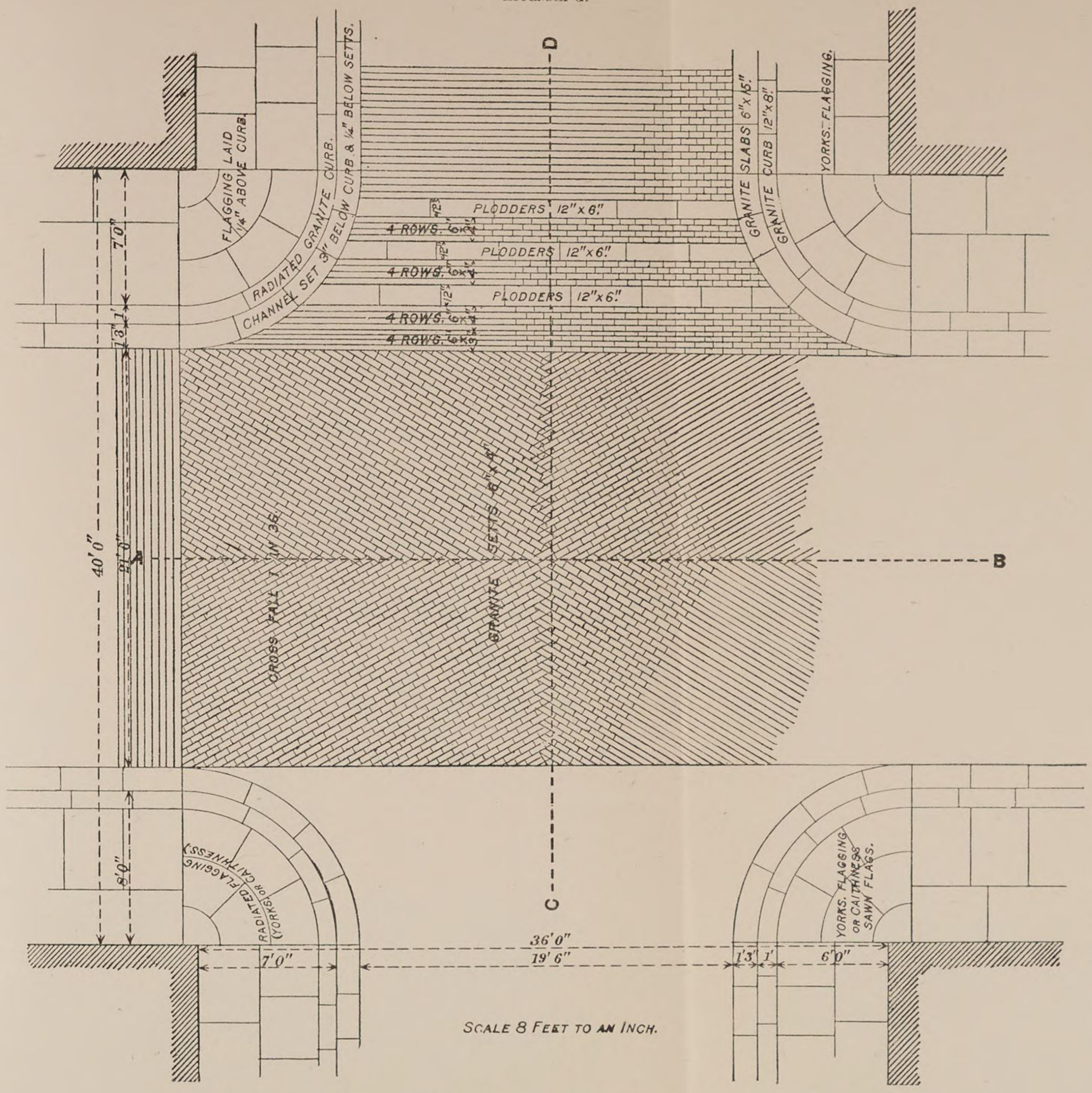


SCALE 6 FEET TO AN INCH.



SCALE 8 FEET TO AN INCH.

AB and CD should be perfect gradients, coinciding at their point of intersection—the carriageway to have a camber of 1 in 36 at A and B, which is to be reduced by raising the line of channels so that when the line CD is reached there will be no camber; this will give a suitable "round" to the crossings at the ends of the 36-foot road, and the water from the carriageway will be thrown toward the four corners.



SCALE 8 FEET TO AN INCH.

See note in Appendix F as to levels.

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